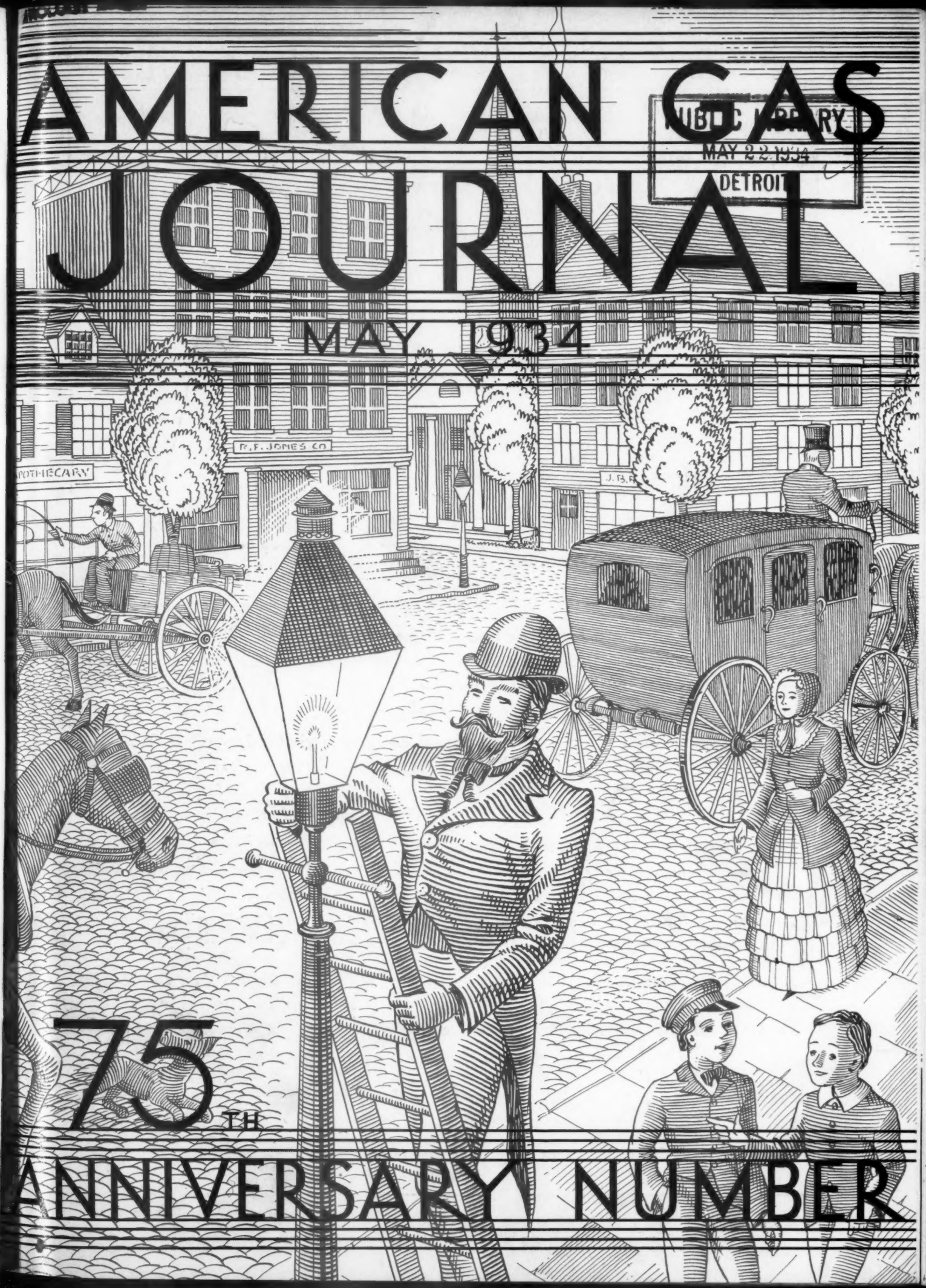
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MRS. MODERN prides herself on being up-to-date in all things. She lives, moves and has her being in the light of *today*, with her face steadily turned toward *tomorrow*. She keeps abreast of current happenings, fashions and new ideas and developments affecting the home. In this realm, hers is the last word as well as the first . . . .

You are absolutely dependent on her good will. She dictates the lines you must handle. She decides where and how you must do business. For Mrs. Modern is *your customer* — the average woman of today . . . .

Mrs. Modern demands leisure and time for other interests besides cooking. She refuses to spend all of her day in the kitchen. Nevertheless for the time she does spend there, she insists that the kitchen be as modern and pleasant as any other room in the house . .

That's why Magic Chef appeals to her. She sees in it the *gas range of today* and for *today*, meeting her requirements of style and beauty, measuring up to her standards of modern efficiency, convenience and ease of operation.

Mrs. Modern likes her last word as well as did her mother. That's why she likes Magic Chef gas range, the last word in modern cooking appliances . . .

Look for the Trademark
Magic Chef
AMERICAN STOVE COMPANY

If you haven't seen the Magic Chef Portfolio for Spring, write for a copy.

AMERICAN STOVE COMPANY

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AMERICAN GAS JOURNAL, May, 1934, Vol. 140, No. 5. Published monthly by American Gas Journal, Inc., at 34 Crystal St., East Stroudsburg, Pa. Executive and Editorial offices at 53 Park Place, New York, N. Y. Entered as second-class matter, October 17, 1928, at the post office of East Stroudsburg, Pa., under the Act of March 3, 1879.

AMERICAN GAS JOURNAL

Established 1859

MAY 1934

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We desire to tender our sincere thanks to the many gas companies, manufacturers and individuals who have contributed so generously of old pictures, data, etc., which appear in this 75th Anniversary Number.

Cover design—"An Old Flame: The Gas Man's First Love"—by L. Foster.

Drawings by George DeLara, Frank P. Curley and Henry M. Riley.

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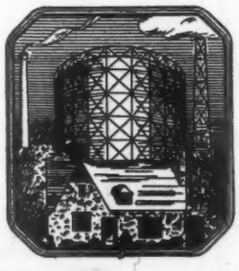

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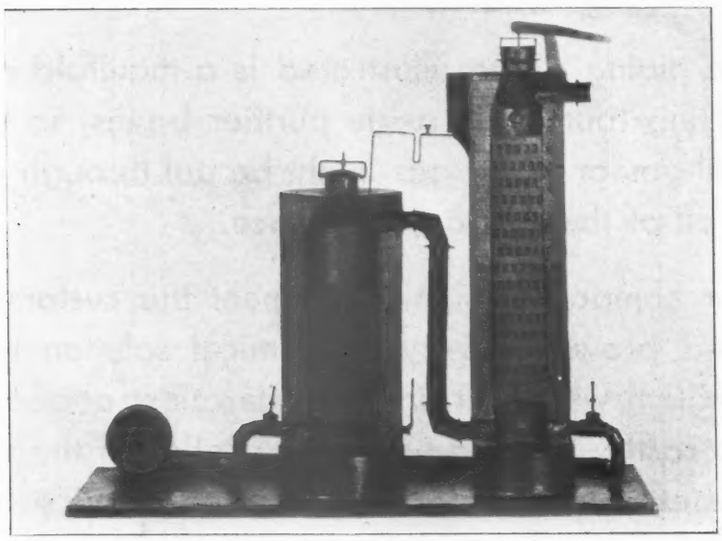

Patent Office Model - Original Lowe
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Improved Double Superheater Lowe Water Gas Apparatus
Method of reversing make of gas through Generator
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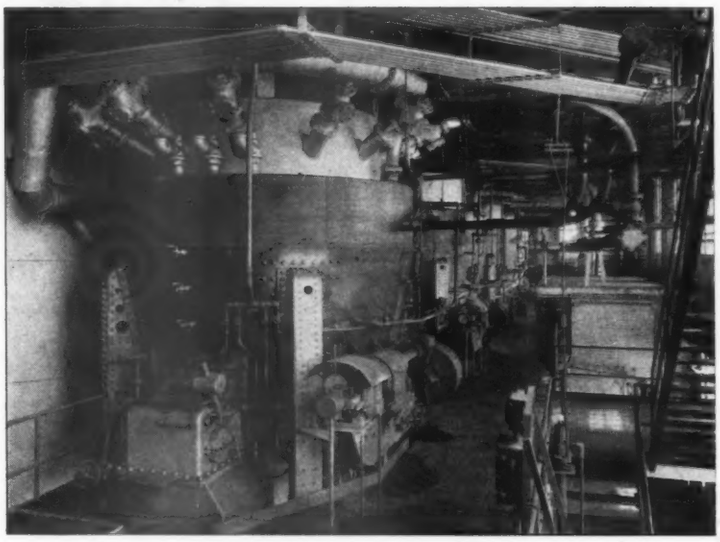

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with Reforming Process

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1882 - 1934

U. G. I. has made available to the gas industry many developments and improvements in gas manufacture, distribution and utilization . . . methods that have been largely instrumental in enabling the industry to keep pace with the constantly increasing demands for more and better service that have resulted from the acceptance of gas as the ideal fuel for the home and for industry.

"No community can grow faster than its public utilities"

THE UNITED GAS IMPROVEMENT COMPANY

Philadelphia Penna.

75 YEARS AGO AND TODAY

The year prior to the election of Abraham Lincoln to the presidency of the United States witnessed the birth of the American Gas Journal. It marked the forty-third anniversary of the American gas industry. It was the tenth anniversary of the introduction of gas service to the residents of the City of Brooklyn.

In the intervening years the American Gas Journal has marched along with the progress of the gas industry. It has recorded the industry's development, reported its activities and reviewed its problems. It has ably served gas companies as they developed and furnished their customers with the Great American Servant.

The gas industry may well be proud of the American Gas Journal. It appreciates the capable manner in which the Journal has been conducted. It realizes the information the Journal has reported of the progress made in manufacture, production, distribution and utilization of gas for industrial and domestic uses.

For these services The Brooklyn Union Gas Company, on its 85th anniversary, extends congratulations to the American Gas Journal on its diamond jubilee. May its development continue along with the progress of the industry it serves.

THE BROOKLYN UNION GAS COMPANY

Birthday Greetings

The second oldest gas utility in these United States extends its warm congratulations to the oldest gas journal on the occasion of its seventy-fifth birthday.

Although gas first flickered forth in Boston in 1822—in an apothecary's shop, to be exact—yet it was not until January 1, 1829, that a permanent gas plant was constructed in Boston and public street lamps regularly installed and lighted in Dock Square.

The old *Boston Almanac* described the gas works then in use with these words:

"The gas made at this establishment is a compound of coal and resin, and is esteemed for its brilliancy and illuminating power. There are three gasometers connected with the company's works, two in Hull street, each of forty feet in diameter, and one in Washington street at the extreme south part of the city, of eighty feet. This is the largest gasometer in the United States and contains fifteen thousand feet of gas."

Today, one domestic customer may consume a monthly amount of gas equal to the entire supply daily offered to all Boston a century ago. Our daily gas output now averages 32,000,000 cubic feet.

Progress! And the forward march of this company and the gas industry as a whole has been painstakingly, faithfully, recorded month after month, year after year, for seventy-five years by the American Gas Journal.

Only merit could have withstood the battering tests of so many years, and the enduring performance of reporting consistently the activities of a vast industry is indeed an achievement and a victory over the forces of time and change.

Boston Consolidated Gas Company

HERE'S ONE SURE WAY GAS COMPANIES CAN *Save Money!*

Standardize on NATIONAL Scale Free Pipe for service lines! This will eliminate frequent interruptions on account of repairs and replacements, due to clogged orifices, or to pitting. The clean, smooth surfaces of this pipe have no scale to break off and start these troubles because the NATIONAL Scale Free Process (applied to butt-weld sizes ½ to 3-inch) eliminates the scale. This process was developed by National Tube Company and has made NATIONAL the outstanding pipe value for gas service. Read the 5 outstanding advantages listed to the left; they sum up the reasons why this pipe gives assurance of longer life, better service, and greater economy. For your next requirements be economical—play safe at the start—insist on NATIONAL—*The Original Scale Free Pipe.*

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1. Minimized corrosion—particularly pitting. 2. Better base for galvanizing or other protective coatings. 3. Full delivery capacity—less friction loss. 4. No damage to valve seats; no clogging of small orifices. 5. Greater strength at the weld —due to the extra rolling in the process.

All National Galvanized Pipe is given a special chromate treatment to resist discoloration and the formation of white rust. This patented process preserves that smooth glistening surface or metallic lustre which is characteristic of good galvanizing.

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NATIONAL SCALE FREE PIPE
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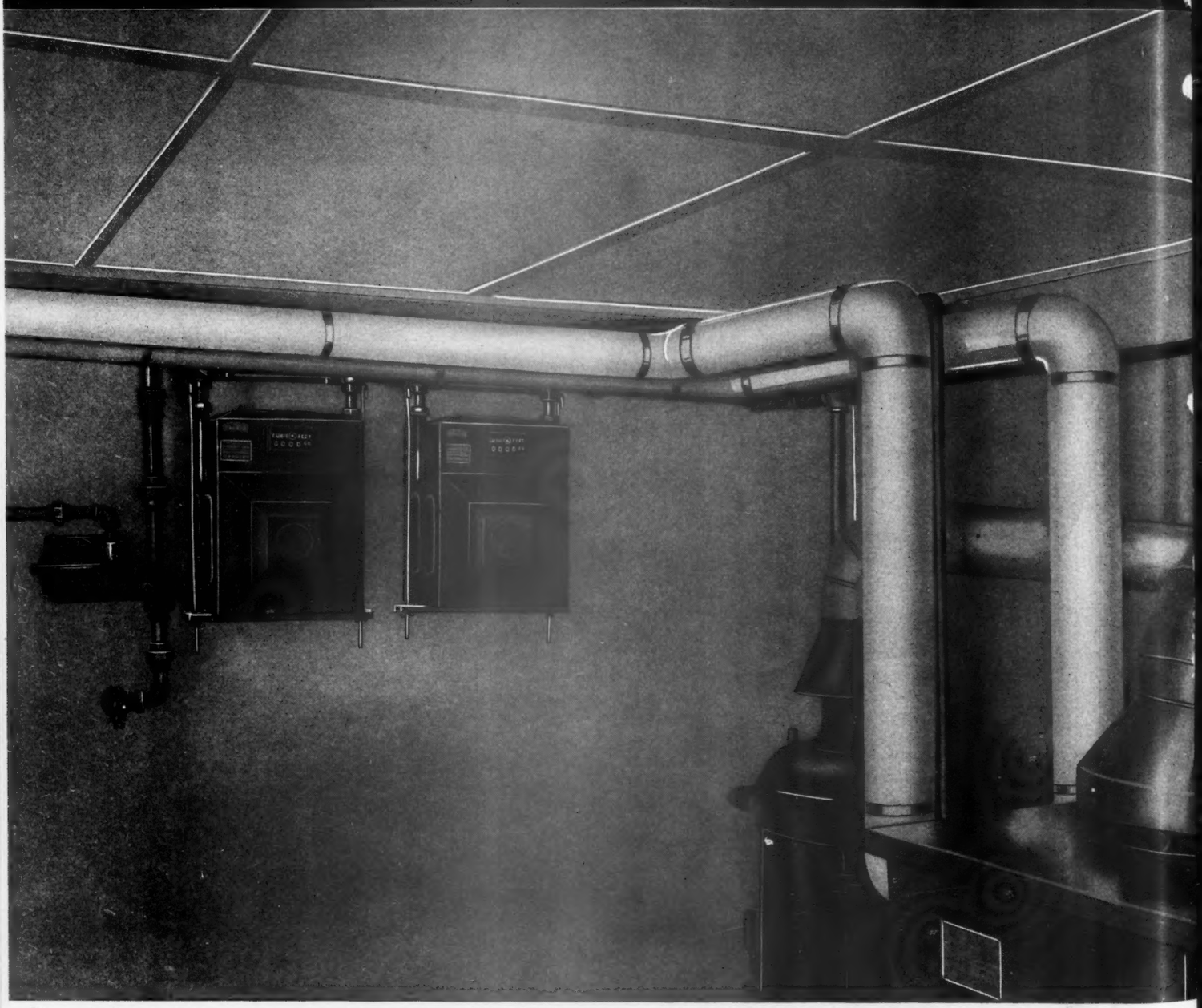

[An ideal installation; American Meters for security of accuracy, and a Reliance Regulator for close pressure control.]

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Los Angeles Philadelphia Pittsburgh New York San Francisco Tulsa

Early tin meter reproduced from an 1867 catalog of American Meter Company. This company was then 31 years old.

We salute the alert gas company executives who are assuming leadership in the modernization of ranges, appliances and meters as a means of keeping the gas industry in step with the van of progress.

Loads are being increased . . . customer good will is being strengthened.

In terms of simple economics, meter modernization not only is giving gas companies the advantage of the larger capacities of today's meters, but it is also definitely assuring savings on maintenance for years to come.

Advanced developments in both design and materials are minimizing preventable causes of removal due to premature failure of obsolete equipment. This reduces customer complaints and stimulates further confidence in gas company equipment.

American Meter Company products and service are calculated to net you the greatest possible return on your meter dollar.

AMERICAN METER COMPANY

INCORPORATED

EST. 1836

of Course We Remember

FOR one hundred and eleven years New York's oldest gas company has served the City without interruption. At the time of the Journal's first issue the New York Gas Light Company, antecedent of the Consolidated Gas Company, was in its thirty-sixth year, serving an area of approximately 1,000 acres through 130 miles of pipe. Indeed, the entire industry which the American Gas Light Journal undertook to serve in 1859 numbered scarcely three hundred gas companies throughout the nation.

While gas has been largely supplanted for lighting by electricity, its usefulness as an ideal heating agent has been extended until it is now the standard fuel for cooking, as well as for a variety of other uses. New York City has grown until some three thousand miles of mains are required to serve its huge population. Several individual customers each consume daily an amount of gas equal to the entire City's requirements in 1859.

If William W. Fox, President of the New York Gas Light Company in 1859, were alive today, we believe he would join this organization in extending its congratulations to the publication of which he was the first subscriber.

TO SERVE NEW YORK

NRA

CONSOLIDATED GAS COMPANY *of* NEW YORK

The Boswell of The Gas Industry

By HENRY M. RILEY

Editor, American Gas Journal

Foreword

GAZE back through the years to July, 1859. Momentous date, that. The country's railroads had reached to the Father of Waters but two scant years prior. A business depression of major proportions had barely started to recede. Abolitionist Brown of Osawatomie was making ready to stage his raid on the government arsenal at Harper's Ferry and thereby quicken the fires of civil war which already smouldered ominously, while Mr. Lincoln completed his preparatory years in statesmanship before an election which was to launch him into the most arduous term ever experienced by a White House tenant and eventual martyrdom.

Furnishing a connecting link with the earliest days of the Republic, bent and aged veterans of the Revolution still lived, and in their second childhood prated of Cornwallis and Yorktown.

And sprightly business men in their late sixties vividly recalled their visit to Mr. Peale's museum in bustling Baltimore town in 1816, there to view with mingled skepticism and wonder the new illumination from gas, "without oil, tallow, wick or smoke"; still others remembered that amazing first use of natural gas in Fredonia, N. Y., in 1825.

Out in Pennsylvania, at the confluence of the Allegheny and Monongahela Rivers, Pittsburgh was beginning to come into its own as an iron and steel manufacturing center; indeed, so accelerated had become the manufacturing activities of the country as a whole, that it was fast throwing off its subservience to the mother country in this regard.

The lure of precious metals was still in the air. At Hang Town and other mining centers in California grizzled men still delved impetuously into Mother Earth in order to wrest therefrom a short cut to wealth by virtue of striking in plenteous quantity that ever magic metal, gold. And in the year in question, another feverish rush for precious metals was in the making—for had not "Pancake" Comstock just stumbled upon that amazing lode of gold and silver in Virginia City in far off Nevada?

And ever the tide of humanity pressed westward, pushing the frontier closer to the Golden Gate. Conestoga wagons still set bravely forth on the long trek from Saint Jo, Missouri, the western terminus of railway transportation. Perhaps the evening before their hazardous trip some of the male members congregated under the corner gas lamps in old Saint Jo, and, being slightly in their cups, sang "Oh! Susanna!" long and lustily. For that matter, nearly fifty years later it is well within the limits of veracity to aver that convivial blades, similarly in their cups, foregathered beneath the selfsame beacons and also sang long and lustily—this time, "Sweet Adeline!"

Truly times of high adventure—times when, rugged individualism was in the saddle, courageously ushering the country into a new era.

Turn eastward the magic of imagination. It is early summer in fifty-nine. Down in Wall Street, in New York, several members of the banking firm of Murray & Company are anxiously waiting. Gas lamps—quite likely designed by Tiffany—shine on strained faces. A printer's devil dashes into the office,

his arm curved into a rigid semi-circle as he hugs a bundle of magazines to his side. An excited grasp at the contents of that tense arm of the ink splotched printer's devil! Apprehension is sponged away from the countenances of the members of the firm of Murray & Company. For right courageously have the hand-set presses undergone the pains of typographical labor—a new trade paper is born, one of the country's very earliest. At the breast of a potentially mighty industry, which has grown from the public demonstration of gas lighting in Mr. Peal's Museum 'way back in 1816 to three hundred odd gas companies stretching from Portland, Maine, to far-flung Frisco, and from Chicago to the Lone Star State, suckles an infant publication which up through the years—seventy-five of them—is to carry high the ethics of the publishing craft and indeed is to become the Boswell of the American Gas Industry. Here in these stirring days came into being American Gas Journal.

Up to this time, in a manner of speaking, the American Gas Industry—with its lamp posts dispelling nocturnal darkness in the highways and byways and a few gas lamps in homes of affluence—had been preparing the stage for a gigantic program of wise expansion and development, very like an orchestra rendering a spirited overture. And now the curtain was to rise and now the real and mighty drama was to begin. And now a publication worthy to record the progress of this vigorous, ever expanding play was at hand, girding its editorial loins for a task of service which "none shall rue."

Early Years

IF A trade publication has kept step with the industry which it serves, especially over a relatively long period of years, it is rather difficult to chronicle its history without simultaneously setting forth the history of the industry itself—they are indeed synonymous. Accordingly, in this brief and sketchy narrative, your editor freely admits that it will not be an easy task to keep the two phases from intermingling, and, for that matter, he has little or no intention of so doing.

The first issue of *American Gas Journal* — then under the name of *American Gas Light Journal* — made its appearance on July 1st, 1859. Considering its newness and the times it was a right robust paper of some sixteen pages and boasted of not a little advertising. It — remarkable achievement—was self-supporting from the start, and was sponsored and published by John B. Murray & Company, bankers, of 40 Wall Street, New York City.

As might be suspected, Murray & Company were interested in promoting gas light shares as an investment and, in turn, the formation of additional gas companies whose roster at this time included some three hundred and seventy-six separate and distinct organizations for supplying their respective communities with gas service. Incidentally, the total capitalization of these companies scarcely exceeded forty millions of dollars and the yearly gas output is estimated at 5,000,000 M cubic feet.

In planning the paper it was originally proposed to confine its scope to listing various gas stocks, their price trends and similar financial information pertaining to the gas business. However, before the first issue went to press it was realized that the horizon must be broadened; hence it reached the hands of its initial subscribers as a real informative and educational printed medium. Wisely, then, did Murray & Company lay the foundation for a gas man's magazine that was without bias or ulterior motive and that, within the bounds of editorial ethics and propriety, could function with the greatest benefit for its subscribers and the industry.

"Oh, Susanna!"

As to who its first editor was, it is difficult to ascertain, there being no title of such a nature printed on its editorial page or elsewhere in the early issues. It is thought that the senior member of the firm of Muray & Company officiated in this capacity. Even so, he either was closely conversant with the gas industry or else had free access to the advice and judgment of those who were—the nature of its editorial contents attests to this.

To Mr. Wm. W. Fox, president of the New York Gas Light Company, of New York City, goes the honor of being the first subscriber. In the second number, published August 1st, 1859, appears an excellent wood cut of Mr. Fox, the first cut of an editorial nature to be used.

Starting in the first number and running for some time thereafter was featured a listing of gas companies in the United States, Canada and Cuba. The dates of organization, capitalization, value of shares, kind of gas made and other pertinent data were included in this listing which was compiled by the publisher and, though somewhat incomplete, con-

stitutes the first summary of its kind ever published and, therefore, the granddaddy of subsequent compilations and statistics.

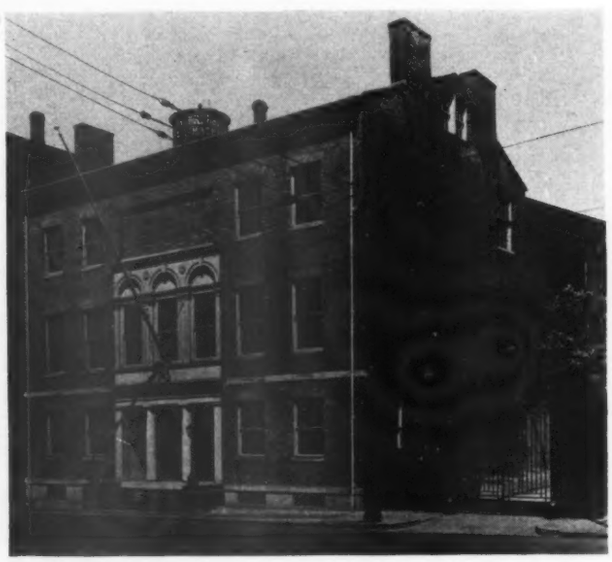
By the time the second number came from the press it was announced that the *Journal* had retained a staff of experts to advise with it as to editorial contents. This included such then well-known names as Professors Aiken, of Maryland University in Baltimore, Fraser, of the University of Pennsylvania, and Renwick, of Columbia College; also, noted engineers, among whom were Cresson of the Philadelphia Gas Works, Torrey, United States Assayer, Schultz of the U. S. Assay Office and numerous others. Here again did Murray & Company exercise rare sagacity and thereby guaranteed the industry a paper of strength and distinction.

Old Gas Harbor Light, Savannah; Erected 1854

System and method which were later to receive the more intriguing appellation of "efficiency" were first suggested in the third number wherein, under the title, "System of Accounts," is noted the following:

"It is evident to us that some general system of keeping accounts might be adopted by all the gas-light and water companies, in order to simplify that department of the business. Although a private matter with each company, with which other companies have nothing to do, yet, any improvement in it could not but be acceptable, and if the various companies will send us their forms, we will glean from the mass what we think the choice points, and present a skeleton of them in a future number."

However, a number of years were to pass before an out-and-out article on the subject of accounting broke into print, the same being "A System for Keeping the Books and Accounts of Gas Companies." The author, W. P. Fodell, was Secretary and Treasurer of the Northern Liberties Gas Company of Philadelphia. This article was written in four installments and thereby claims the honor of being the first serial in the *Journal*. It was started in the issue of July 2, 1868.



Peale's Museum, Baltimore

An institution pregnant with useful ideas, this lusty new gas paper. In its second number, August, 1859, it comments on the value of a proposed Gas Light Association for the state of New York as follows:

"The proposed association will, if established, be beneficial alike to companies and consumers — to the companies, because it will produce a constant interchange of opinion upon all matters connected with the economical management of gas works, and to the consumers, because it will be the means of cheapening the cost of production, and so enable the companies to lower the price of them. It will serve to remove those prejudices which are founded in ignorance, and which are as vexatious to the managers of gas companies as they are irritating to the gas consumers, for it will enable those who possess the proper information to enlighten the public, by spreading before them, from time to time, such explanations as cannot fail to convince the intelligent that a business which requires so much capital, and such nice scientific management, must, to be prosperous, be honestly as well as ably conducted."

This association,

whose constitution and by-laws were adopted November 16, 1859, had as its first president, Mr. William W. Fox, and its treasurer, Mr. Charles Roome.

Not content with this initial observation, the *Journal*, in its October 1859 number, goes considerably further and recommends a national gas light association in noting that,

> "Before the centralized strength, and authenticity of information, which will be the necessary results of a National Gas Light Association, a thousand fallacies of practice will give way—by means of the fraternization of gas engineers so caused, a thousand asperities will be softened, and countless prejudices removed. Its purpose being of enlarged benefit, its realization will confer dignity upon gas-lighting, and give prominence to its exponents."

Tablet Erected by Daughters of The American Revolution, 1925, on Site of First Gas Well at Fredonia, N. Y.

Ever the gas industry has had its periods of romance and in a like manner the *Journal* has experienced the thrill of pulse-quickening moments. Somehow, history back to the earliest times features a rider dashing madly toward a goal on foam-flecked steed, his path beset with countless dangers. And so it was when the first lot of subscriptions came east from Oregon and California in the early days of 1860.

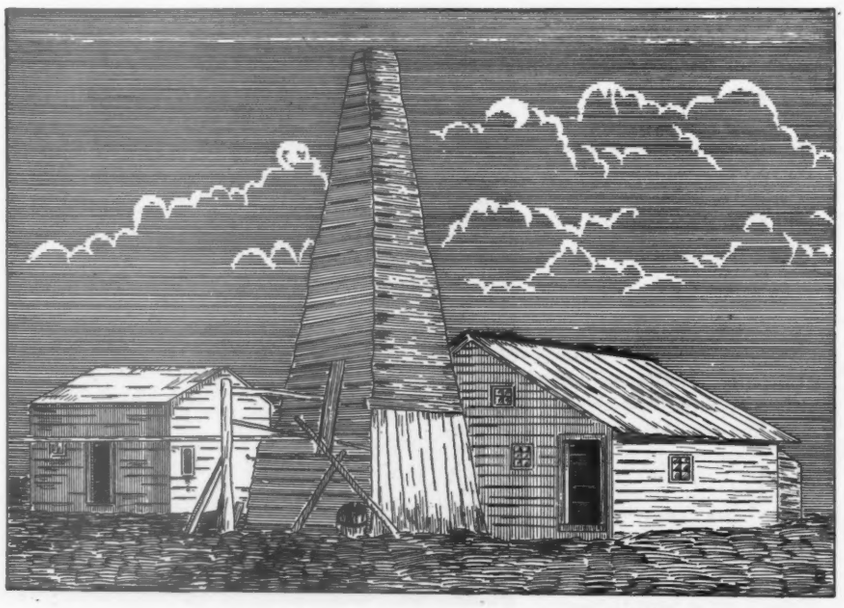
One's imagination can easily reconstruct the scene. A rider of the Pony Express on his half-breed mustang gives a hasty glance backward, notes the few dim gas lights of Sacramento and spurs eastward. In the two thousand dangerous miles the last relay of riders will not again see those yellow flares until Saint Jo is reached. To Placerville, Carson City, Humboldt and thence through Ruby Valley to Salt Lake City the trail wends its tortuous way. The first rider and several others have long since completed their appointed stretches and still others carry the precious two leathern wallets into Fort Bridger and then up and over the Continental Divide to Fort Laramie. More mad riding to Julesburg and down the Platte River to Fort Kearny, until finally the last relay sights faintly ahead the few scattered gas lights of Saint Jo.

One can fancy the greeting in Saint Jo and the interchange of news, but this is a gas story and,

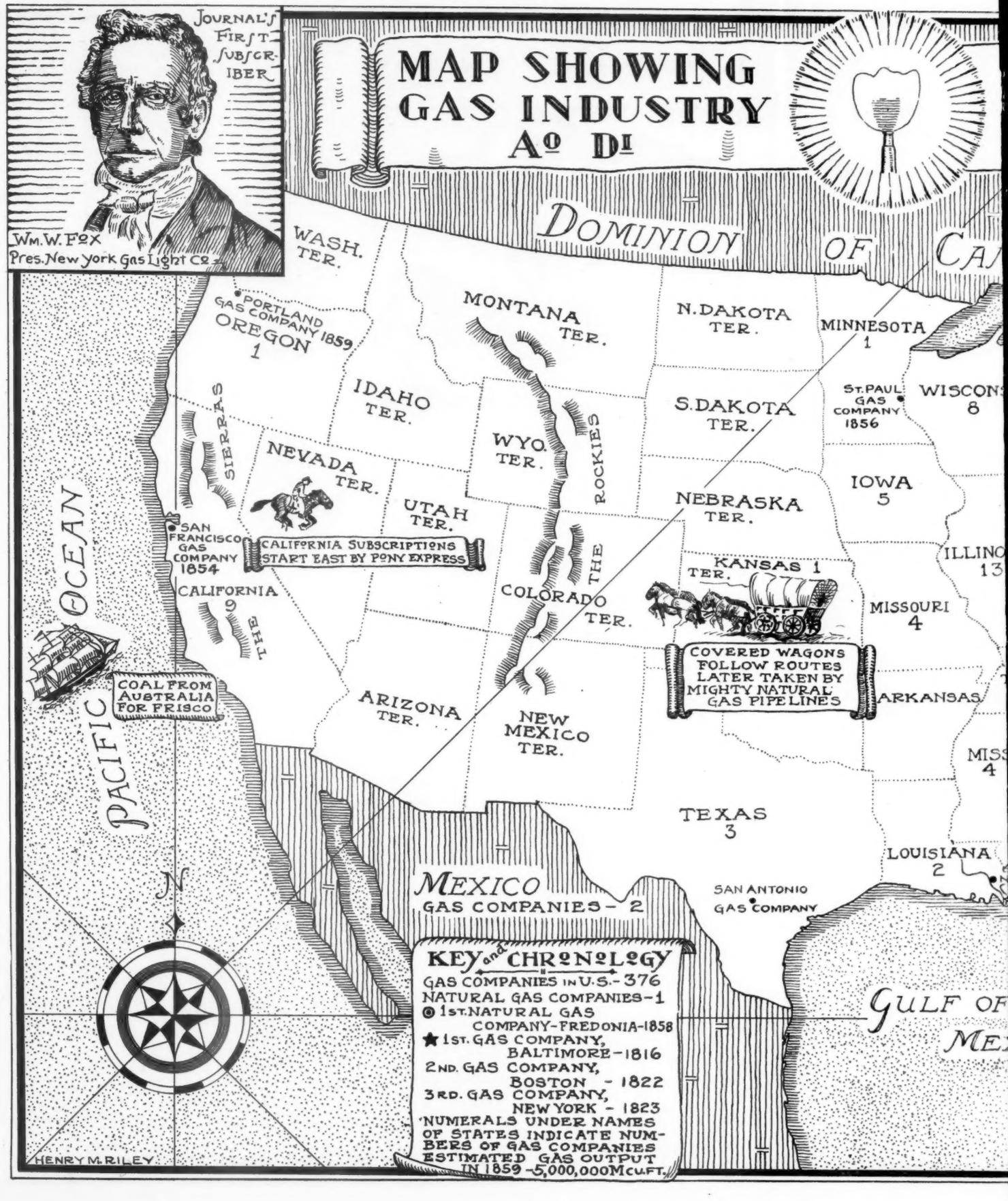
J. G. Eastland—Rugged Type of Pacific Coast Gas Executive in the fifties and sixties. An early Subscriber to the Journal

as far as those bygone days of the *Journal* are concerned, we must conclude this item with the observation that from Saint Jo the mail goes east by train. On board are the earliest far western subscriptions to the paper and thus was first established a gas connection, editorially speaking, between the Atlantic and the Pacific.

Another item surcharged, per-



Early Natural Gas and Oil Well Housing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COVERED WAGONS FOLLOW ROUTES LATER TAKEN BY MIGHTY NATURAL GAS PIPE LINES
ARKANSAS
COAL FROM AUSTRALIA FOR FRISCO
ARIZONA TER.
NEW MEXICO TER.
PACIFIC OCEAN
TEXAS 3
LOUISIANA 2
MEXICO
GAS COMPANIES – 2
SAN ANTONIO GAS COMPANY
GULF OF
ME
N
KEY and CHRONOLOGY
GAS COMPANIES IN U.S. – 376
NATURAL GAS COMPANIES – 1
◎ 1ST. NATURAL GAS COMPANY – FREDONIA – 1858
★ 1ST. GAS COMPANY, BALTIMORE – 1816
2ND. GAS COMPANY, BOSTON – 1822
3RD. GAS COMPANY, NEW YORK – 1823
NUMERALS UNDER NAMES OF STATES INDICATE NUMBERS OF GAS COMPANIES
ESTIMATED GAS OUTPUT IN 1859 – 5,000,000 M CU. FT.
HENRY M. RILEY

AP SHOWING
AS INDUSTRY
Aº Dˡ
DOMINION OF CAN
MONTANA TER.
N.DAKOTA TER.
MINNESOTA 1
ST.PAUL GAS COMPANY 1856
WISCONSI 8
S.DAKOTA TER.
WYO. TER.
ROCKIES
IOWA 5
NEBRASKA TER.
ILLINOIS 13
KANSAS 1 TER.
COLORADO TER.
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MISSOURI 4
COVERED WAGONS FOLLOW ROUTES LATER TAKEN BY MIGHTY NATURAL GAS PIPE LINES
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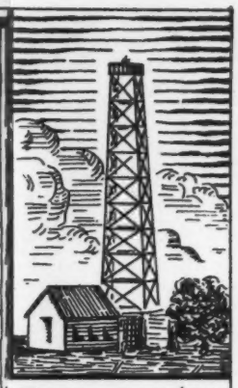
. GAS COMPANY, NEW YORK - 1823
TERALS UNDER NAMES STATES INDICATE NUMRS OF GAS COMPANIES
TIMATED GAS OUTPUT IN 1859 - 5,000,000M cu.ft.
GULF OF
MEX

STATUS OF IN AMERICA 1859



FREDONIA, N.Y.
FIRST NATURAL
GAS COMPANY

ANADA

GAS COMPANIES – 23
1ST. COMPANY- HALIFAX 1843

MAINE 10

VT. 8

N.H. 6

MASS. 49

CONN. 14

RHODE ISLAND 7

SCONSIN 8

MICHIGAN 8

NEW YORK 70

PENNSYLVANIA 47
1820 • FIRST USE OF NATURAL GAS NEAR PITTSBURGH

N.J. 19

MARYLAND 6

DEL. 3

WHALERS SIGHT GAS LIGHTS OF OLD SAG HARBOR

OHIO 29

LLINOIS 13

INDIANA 7

VIRGINIA 11

D.C.

KENTUCKY 5

N.CAROLINA 8

TENNESSEE 4

BAS

SOUTH CAROLINA 2

MISS. 4

ALABAMA 3

GEORGIA 6

GAS BEACON SAVANNAH ERECTED 1852

ATLANTIC OCEAN

UNITED STATES IMPORTS LARGE QUANTITIES OF EQUIPMENT & CANNEL COAL FROM ENGLAND

PROF. T. S. C. LOWE PLANS FOR BALLOON TRIP TO EUROPE

ANA

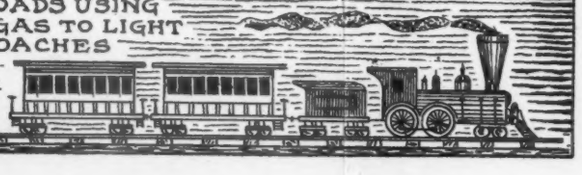
FLORIDA 7

NEW ORLEANS GAS COMPANY 1833 USES SLAVE LABOR

F OF

MEXICO

RAILROADS USING CITY GAS TO LIGHT COACHES



haps, with no little romance lies in the fact that at this time the *Journal* had retained to translate foreign gas news for its readers one, Captain Theophilus d'Oremieulx, late professor of French at the U. S. Military Academy at West Point. His former pupils at the Academy doubtless relearned from their French professor tales of daring of Napoleon and Ney and right lustily emulated these military geniuses in the armed controversy that soon was to rage.

Touching briefly upon the subject of advertising, one notes in the very first issue the following:

TIFFANY & CO.,

JEWELLERS AND IMPORTERS OF
ELEGANT ARTISTIC PARIS GAS CHANDELIERS,

BRACKETS, PENDENTS, &C, IN BRONZE AND GILT

No. 550 Broadway, New York

Quite a sight it must have been in that long ago for the elite to view the "elegant gas chandeliers" in a store that was to become internationally famous.

Some one, along about the latter part of 1860, must have found the job of editing the paper more than passing arduous, because in the December issue of that year we read that—"The Proprietor of *The American Gas-Light Journal* has the pleasure to announce that the editorial department will be hereafter under the charge of Mr. C. Elton Buck, a young gentleman of some promise, whose scientific education has been directed by Professor James C. Booth, author of Booth's Encyclopaedia of Chemistry, and recently assistant of Dr. Campbell Morfit of this city. With this introduction, Mr. Buck will proceed to speak for himself."

Early Journal Subscriptions from the Pacific Coast Come East by Pony Express

Colloquially speaking, the proprietor said a mouthful when he cited young Buck's training and qualifications. He needed them—the gas industry by now was ramifying with quickening pace.

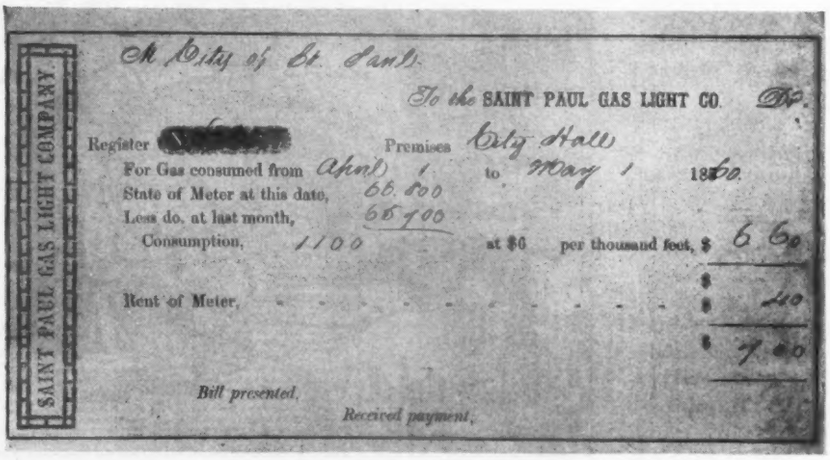
Came the great Civil War, and throughout the strife the Journal was to record various items bearing upon the same insofar as the gas industry was involved. Shortly after the affair at Sumter it noted: "That this war will be brief, we sincerely hope; that it will be bloody, we greatly fear; that it will be successful in maintaining the Constitution, the Union, and the Government, we firmly believe and ardently desire."

As in similar national emergencies, the gas industry's employees, from both the North and South, heeded the call to the colors in great numbers. In New York, Roome organized his own batallion from the employees of the New York gas company and drilled them with true gas house discipline. Happily, except for the South, whose gas companies found it increasingly difficult to procure gas making materials and supplies, the industry as a whole made good progress during the conflict.

In January 15, 1863 issue of the *Journal,* the editor calls attention to the fact that "there are over five thousand plumbers and gas fitters in the army at this time." Possibly each carried a wrench along in his knapsack and laid about to good advantage with it when other arms were missing. Or indeed, one of them might have loaned this spare weapon to the worthy Professor Lowe when that versatile gentleman was making gas for balloon inflation preparatory to ascending in order to take observations on the Confederate batteries at Fair Oaks, Virginia, in 1862.

Those old editors early displayed that saving grace so necessary for editorial work,—especially gas editorial work—a sense of humor. In August 15, 1863 issue we find editor Buck inserting an item having to do with a suggestion from far-off Bombay that gas might be derived as a distillate from dead Hindoos.

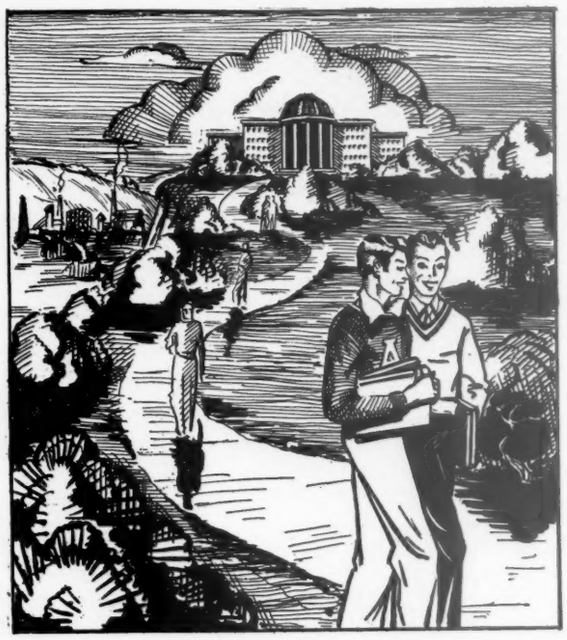
The first reference to nat-


SAINT PAUL GAS LIGHT COMPANY.
The City of St. Paul
To the SAINT PAUL GAS LIGHT CO. Dr.
Register [redacted] Premises City Hall
For Gas consumed from April 1 to May 1 1860
State of Meter at this date, 66.800
Less do. at last month, 65.700
Consumption, 1100 at $6 per thousand feet, $ 6 60
Rent of Meter, $ 40
$ 7 00
Bill presented.
Received payment.

Early St. Paul Gas Bill—Gas at Six Dollars per M!

ural gas occurs in September 2, 1862 issue. Here Prof. E. B. Andrews of Marietta College, in an article relative to the geology of oil, tells of the forcing of oil to the surface by virtue of the pressure of the gas.

Hurriedly striding up the years we note reference to a strike at the Philadelphia Gas Works in 1868 and a spicy discussion of the evil effect of taxes on gas companies — this latter also in the same year. A year later we see the name of a famous inventor in the pages of the paper, Hiram S. Maxim of firearm fame, who had invented a portable gas machine. It is well to observe that during the early years of the *Journal* there were being used a number of private or individual gas making plants or machines for illuminating large buildings and factories.



September, 1871, Journal Suggests Gas Engineering Course

In January 3, 1870 issue is an item of relatively high importance—this has to do with resuscitation. Like any other large and important undertaking which must make allowance for the human element, the gas industry from time to time numbered its casualties. Men of rural calling persisted in blowing into city hotels with their showiest carpet bags and blowing out the gas with their gustiest breath. Then too, those eager to shake off this mortal coil frequently chose the gas route as a painless path along which to make their exit; not to mention similar accidents of an unavoidable nature. In any event the editorial, "Noxious Gases—Remedies and Antidotes," proceeds rather widely to discuss the question; suggests educating the public and recommends that hospitals study the use of oxygen in asphyxiation cases in specially equipped rooms.

Meanwhile the *Journal* and the gas industry continued to flourish and prosper. Whoever sold advertising space for the paper obviously worked under the well known slogan, "The sky's the limit," for all sorts of extraneous advertisements appear on its pages—clothes wringers, pianos, oil lamps, coffee, railroad time tables, and even an allegedly superior brand of Bitters. Possibly advertising this latter commodity might have been inspired by the fact that it became customary to douse the innards of the wet meters now and then with whiskey in order to prevent freezing. Frequently the fellows who doused the innards of the meters would douse their own innards—with meter whiskey, of course—and perhaps the Bitters' advertisers desired that the latter dousing be performed with a distillate worthy of those jovial gas souls who managed the particular task.

By and large, Mills Landon Callender was an amazing man —one of parts, assuredly. He would be a prodigy in this present day and age. His history is impressive. He was born in Chenango County, New York, in 1827. This gentleman came of fighting stock, for he was descended from the Livingstons of Callender, Scotland. Of these, the Earl of Livingston lost his estates because of a rebellion in 1715. The name Callender appears in a Boston, Mass., directory in 1789. At the age of 21 he joined Col. Stephenson's regiment as a sergeant, sailed to the Isthmus, boarded ship on the Pacific side and proceeded to San Francisco. Thus he antedated the first gold rush and, indeed, he entered the gold mining business and later became a member of the Vigilantes. He also found time to serve as Clerk of the Town Council.

In 1852 he turned his attention to journalism, with Eugene

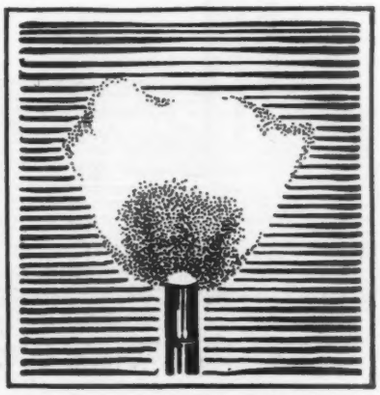
Plagge's Dream

Casserly, who later became senator from California, established the *San Francisco Standard*. The great fire in 1853 destroyed the newspaper offices and this, together with a desire to see his home and friends in the east, caused his return to this birthplace where he occupied his time with various inventions. In this connection he was prolific: a no-chimney burner for lamps, an improvement in fuses for bombs, a marine torpedo,—the latter sold to Eades—an iron clad war vessel which the government was arranging to build when the Civil War ended, and other military and naval enginery emanated from his fertile brain.

In 1866 he joined the *Journal* organization where he soon began to turn his publishing talents to good account and his five years with the paper added not only a luster to its pages but, through his wife and son perpetuated the name of Callender at its mast-head for nearly fifty years. He died in 1871 at the age of 44, his early demise being directly traceable to fever contracted on the Isthmus of Panama on his trip west to San Francisco. The *Journal* interests were taken over by his widow, Amelia M. Callender, under the name of A. M. Callender & Co. and Professor Henry Wurtz, a noted chemist, assumed the editorship in July, 1871.

In this year, September issue, appears another notable suggestion, one proposing the establishment of a course for gas engineers in the colleges.

During these years, from 1859, the gas industry was dreaming dreams that would eventually come to pass. Gas engines for power purposes were making slow but gradual headway; gas ranges were being talked about, advertised and sold—at least sporadically; gas making methods were being constantly improved; gas for fuel purposes was receiving more than scant consideration; crackpated legislators were ever and anon up to their ancient tricks; such stalwarts as Theobald Forstall, Charles Roome and others were placing the industry on a sound basis; natural gas, although in use in only a handful of small communities as city gas, was slowly coming into industrial use, especially in the Pittsburgh area; and, last but not least, the old "gas house terrier," of whom the pen of Walton Clark has written so illuminatingly, was firmly established as the true representative of loyalty, bluff honesty and dogged determination.



The Old Standby

Genus:—Terrier; Habitat: The Gas House

He was a grimy Terrier from the gas house down beyant,
Of chemistry and algebra his knowledge true was scant;
But he'd a horny fist and an honest face and the grit of a brindled pup,
He didn't go much on photometry, but he kept his holder up.
Walton Clark

Great old days! They have left us a rich heritage of inspiration.

Regarding the personnel of the editorial staff as well as the proprietors of the *Journal*, up to January, 1870, the publication had passed from the hands of Murray & Company in the following sequence:

Date	Proprietor	Editor
July, 1859	J. B. Murray	?
Dec., 1860	J. B. Murray	C. Elton Buck
July, 1864	J. W. Bryant	Jas. W. Bryant
Sept., 1865	J. W. Bryant	Jas. W. Bryant Dr. C. W. Torrey
March, 1866	J. W. Bryant	Jas. W. Bryant Mills L. Callender
July, 1866	Bryant, Callender & Co.	Mills L. Callender
Jan., 1868	M. L. Callender & Co.	Mills L. Callender

The Era of Carburetted Water Gas

The year 1873 was important in many respects. A national gas association with Charles Roome at the helm was at last under way; lamp black was regularly being made from natural gas; Lowe had finally completed his investigations of carburetted water gas and had perfected a set which was to be the forerunner of far-reaching developments in gas making.

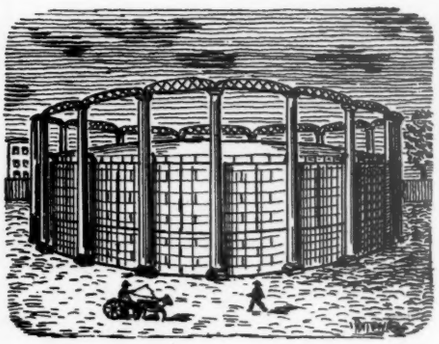
In the pages of the 1874 volume we note, with some amusement, the suggestion by one, Charles Plagge, for keeping the Erie Canal open in winter by way of heating the water with the relatively large quantities of natural gas then being found in the vicinity of the western terminus of that commercial artery. A naive, if not a wild, working of the imagination; however, credit must be accorded this gentleman for at least thinking.

In October, 1875, Mr. G. Warren Dresser assumed the editorship of the paper. Here again the *Journal* was blest in having a genius for the particular task which was growing multifarious by reason of the considerable expansion of the various activities of the gas industry. A word as to his career and qualifications.

G. Warren Dresser was born in Abington, Connecticut, Sept. 15, 1837. The usual prelim-

inary schooling prepared him for West Point where he graduated in May 1861. He was commissioned a Second Lieutenant of artillery and immediately was plunged into the welter of the war between the states.

His service to the Union was both varied and brilliant. Bull Run, Yorktown, Chattanooga, and other hell-sectors saw this young artillery officer in dashing



HARD TIMES.

From every quarter the reports of dull times and depression in business continue to be received. To the laboring classes, and to the mechanics, these are not glad tidings; but, nevertheless, the only thing to be done is to make the best of it. Of course the strictest economy is forced upon many, and often the hand that in prosperous times has quietly, and unknown, helped a less fortunate brother, would now be glad to receive even a small recompense for almost any work that it could find to do. Honest labor finds it hard to get employment, while capital lies almost idle waiting for investment. During the past week the government called for bids for about five million of Bonds, and although the terms were such as precluded the offering of any bid for less than half a million dollars, thus excluding all small investors, still the total amount of the bids for these bonds exceeded sixty millions, at prices above par in gold. This would seem to indicate that there is some money left and that every body does not believe that the country is "going to the dogs" for some years to come. What seems to be wanted by capitalists is safe investment, and if confidence can be restored, and the fact established that hard pan has been reached, there will at once spring up an amount of work that will be sufficient for all who are disposed to work for fair compensation. It has become chronic with too many to cry "hard times" and make no effort to relieve them. There must be concession on all sides, and all classes unit join in the work of revival. Capital and labor cannot afford to act antagonistically.

While "the laborer is worthy of his hire," there is no reason why that hire should be out of proportion to the prices of every thing else which labor produces. While the cause of the depression may be attributed to over production, inflation, undue speculation, or any other cause, still it is of the utmost importance to look matters squarely in the face, and not sit down repining, but after a careful survey determine what can be best done to start again.

Times like these have their benefits although the blessings may be somewhat disguised. And what are the benefits to the Gas Maker? Decreased consumption must enforce greater economy in manufacture, and while the gas manager has to furnish less gas, he has more time for study and improvement. His works being less occupied he has the very best opportunity for overhauling the unemployed portions, and putting them in such thorough order, that when increased demands do arise, he is in a position to meet them promptly, efficiently, and economically. Where apparatus is worn out, or where it has performed all the duty that can be safely and reasonably expected of it, take it out and replace by new and better if there is such. There is no greater mistake than relying upon "patching along," and "making it do for now," for at the very time when you are crowded, and want every particle of power you have, then will your patchwork fail you. Times like these are very important to a manufacture which knows no rest, but is continuous, for it gives an opportunity of putting everything connected with the plant in such thorough order that, when the time comes, it will be doubly profitable to push things.

In reorganization and rearrangement of your works, do not rely too much on your own personal experience—see what others are doing and have done—guard against running in a rut—fully consider and mature plans before commencing. The best advice is always the cheapest in the end. Let everything that is done, no matter how small, contribute to the success of the general plan. Here we are met with the objection that receipts are smaller, and yet you advise greater expenditure. Most assuredly. Let any engineer lay before his board of directors a well-matured plan for increasing the efficiency and economy of his manufacture, and they may be easily satisfied that the time when labor and materials are cheapest is the best time to do work.

The depression of the present cannot continue. the increase in consumption *must* return; and, when it does come, the improved methods will soon save the expense of re-construction.

We fear that this may be considered plain talk, but nevertheless we believe it is true—that there is a little too much "rule of thumb" in the gas business. The popular demand for cheaper gas will soon test the efficiency of this rule. A fair trial of methods founded upon careful study and application of the principles involved, together with a knowledge of the best practical results, will soon show their superiority. Thorough system, order, and cleanliness about the works will soon pay a good dividend.

What the Journal Had to Say Relative to the Depression of the Seventies

action, with duties as drill-master and ordinance expert interspersed. At the end of the conflict he tendered his resignation to enter the profession of civil engineering which activity comprised the handling of many important tasks of a greatly diverse nature.

His editorial stewardship with the *Journal* was more than could be desired, and his far-seeing judgment was of inestimable value to the paper and the entire American gas industry as well. Major Dresser died on May 27th, 1883.

During Dresser's regime the paper made note of the status of Stevens Institute—that eminent center of technical learning which was to supply the gas industry with so many shining luminaries — which, in 1875 had completed its first year.

In the July 3, 1876 issue is to be found the first illustration depicting the Lowe water gas set. This was included in an advertisement announcing that the equipment was being sold by S. A. Stevens & Company, of Philadelphia and New York. In the June 16, 1877 issue there is editorial mention of this new process and also in that number is to be seen a long letter of comment from a Mr. George S. Dwight who was closely associated with Lowe. He notes in part that "we shall make a legitimate business of gas making, and while we respect the solicitude of those who dread a competition never before experienced, we shall certainly expect our share of the business."

For a number of years there was much back-biting and recriminations anent the Lowe process. As faithfully set forth in those issues of the *Journal* of over fifty years ago, the various letters from both opponents and proponents make intensely interesting reading. At one stage of the controversy the *Journal* was accused of having a financial interest in the matter—said accusation being published in its pages, demonstrating the high ethical aims of the paper. The *Journal* did not scruple to publish knocks as well as boosts.

With the invention of the electric light by Edison in 1879 the paper took serious cognizance of this form of illumination which was eventually to supplant the use of gas for the purpose. For quite a number of years from this time on it was to print on its pages much matter relative to the electric light and the growing competition it furnished.

Philadelphia Gas Fitter of 1899

The late seventies was notable from another angle: the appearance of Frederic Egner in the various activities of gas company and gas association procedure. At about this time George Ramsdell was also under way on his long and illustrious career. Both of these gentlemen graced the pages of the *Journal* on occasions too numerous to mention with their contributions, letters, etc. The latter passed to his reward a few years back—the former, in the sunset of his life, may well look back upon a career of distinguished service to the gas industry with a feeling of consummate contentment. As the paper's oldest subscriber we salute him.

The first official summation of statistics of the gas industry came about, as noted in the *Journal*, by the appointment, in Sept. 1880, of Major Dresser by the United States Government to conduct such a census. Incidentally, the results of Mr. Dresser's work in this connection were published in Dec. 16, 1886 issue. This task evidently took considerable time in those days as well as now.

Mention of the incandescent gas light is first observed in July 17, 1882 number. This was not the Welsbach unit. Nevertheless, a few brief quotations should be in order. "The burner is composed of two pipes, one for air and the other for gas. On top of the burner is placed a cap or thimble formed of fine platinum wire gauze. The light is remarkably steady, and its cost is stated to be much less than that of coal gas burned in the ordinary way." Incidentally, this unit was the invention of an Englishman, Mr. James Lewis.

Up to the death of Dresser, in 1883, we hastily cite such items as the first use of blood transfusion in treating asphyxiation cases; A. M. Norton, a gas man, being elected mayor of Nashua, N. H., and the value of gas property in this country being estimated at $200,000,000.

In what we might call the Welsbach Mantle Era of the gas industry and the *Journal*, we find Mr. Joseph R. Thomas succeeding Major Dresser. Meanwhile, carburetted water gas as exemplified in the Lowe process was going along with increasing impetus, and coal gas practice was furnishing its share of progressive activity.

An item of much importance is cited from the Oct. 16, 1883 issue. This has to do with a display of gas appliances — "Apparatus for the Measurement and Testing of Gas; Gas Engines; Gas Burners, Lamps and Globes; Cooking, Boiling and Heating Stoves" — by the Consumers Gas Company at the Toronto Industrial Exhibition. "Perhaps," says Mr. W. H. Pearson who contributed the article, "the most interesting feature of the exhibits—at least to the ladies—was the cooking department. We were fortunate in securing for this department the services of a lady who is not only a first-class cook, but also a first-class talker, and at the same time of prepossessing appearance; and if her efforts, both in the culinary

and oratorical line, do not bear fruit in our receiving a large number of orders for gas cooking stoves next season, I shall feel very must disappointed." One can picture the efficacy with which a combination of good cook, good oratory and good looks literally stood on their heads the gay Canuck gas men, resplendent in their paper collars and handlebar mustaches.

Realizing the importance of the Journal, Mr. George Ramsdell, as of Feb. 2, 1884, sent subscriptions to each of the directors of his company. Also in this year are to be observed such items as the use of gas for cooking in a large New York hotel, the publication of the first convention paper on natural gas, first mention of odorizing natural gas, adoption of uniforms for some of the employees of the Philadelphia company, and the installation of a station meter of 3,000,000 cu. ft. per day capacity in the plant of the San Francisco Gas Light Company.

In the May 17, 1886 issue occurs the first important citation on the Welsbach mantle. Accompanying the short article is a dig by the *London Journal* which says: "This burner is not altogether a novelty in England; having achieved failure here some three years ago." However, in spite of Albion's gloomy observation, the new light grew with increasing brilliance. In April 8, 1889 issue is to be found a paper by Geo. W. Graeff, Jr., on the subject, "The Welsbach Burner as a Commercial Article," the same being read before the Fifth Annual Meeting of the Ohio Gas Light Association, held the previous month in Mansfield.

From this time on the Welsbach lamp gave new impetus to the gas industry and acted as a partial stopgap to the onward rush of electric lighting. In a sense it was the foster father of the use of gas for solely heating purposes which, however, did not begin widespread development until about the turn of the century. Nevertheless, skepticism accompanied the early efforts of this appliance to gain a foothold. Even in the Feb. 25, 1895, issue one correspondent notes that gas companies "might suffer great loss of load" due to Welsbach mantles!

New York Consolidated Holds Fourth Annual Golf Tournament, 1910

Official Seal American Gas Centenary

In the eighties such luminaries as Hickenlooper, McMillen and others were recognized as seasoned veterans in gas matters and still a newer crop of geniuses who numbered in their ranks Walton Clark, A. C. Humphreys, Alfred Forstall and many more were coming to the fore. And always the *Journal* painstakingly put into print these men's observations and findings, to the end that their readers would be kept fully informed of their industry's development.

But old and intriguing illustrations clamor for space, and that nemesis of all editors—the printer — literally shrieks for copy. And in any case, attempting to write this story in a restricted space is provokingly similar to essaying to capture the requisite share of rare old vintage from an open cask with a salad fork. Hence, your editor must hasten to conclude this impoverished narrative of a paper which has remained loyal to and kept in step with its industry which has been so patient with it and has contributed so generously to its growth.

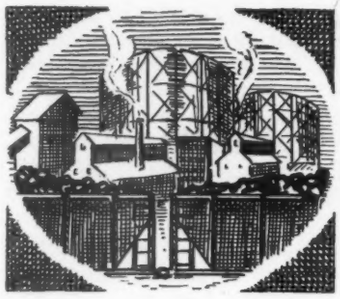
From the time of Thomas as editor we find Cunningham—of whose bluff and honest character and accurate insight into the industry volumes could bewritten—Campbell, Miles, Fairservis

Publication Chronology

Date	Name	Frequency
July 1, 1859	American Gas Light Journal	Monthly
July 1, 1860	American Gas Light Journal	Fortnightly
July 1, 1864	Am. Gas Lgt. Jrl. and Mining Reporter	Fortnightly
Oct. 17, 1864	Mining and Petroleum Standard and Am. Gas Light Journal	Fortnightly
July 2, 1868	American Gas Light Journal	Fortnightly
Dec. 2, 1868	American Gas Light Journal and Chemical Repertory	Fortnightly
Jan. 3, 1876	American Gas Light Journal	Fortnightly
Jan. 7, 1889	American Gas Light Journal	Weekly
Jan. 1, 1917	American Gas Engineering Journal	Weekly
Mar. 5, 1921	American Gas Journal	Weekly
August, 1927	American Gas Journal	Monthly

Ginsberg and the present incumbent serving in the order named. In 1916 we note S. G. Krake gradually acquiring controlling interest in the paper.

And through the aforesaids' tenures of editorship the industry has seen its lighting load almost entirely wiped out; the introduction of a calorific for a candlepower standard; the home virtually revolutionized by reason of the gas range, the gas househeating furnace, the water heater, the air conditioner and other amazing appliances; the gigantic introduction of gas into a thousand and one different industries; the running of natural gas lines hundreds of miles to cities of first rank and thereby refuting those who nearly fifty years prior stated that the supply of this fuel was on the decline; the leavening influence of Home Service; the not always healthy building up of monster holding companies; the eventual formation of a strong central Association.



A kaleidoscope, indeed! And one whose every important changing design has been imperishably and accurately transmitted onto the pages of the *Journal*. There, beginning in ancient tomes,—the thumbing over of whose leaves, that have been so gently touched by the corroding hand of time, engenders almost a feeling of reverence—one may read of the aspirations and success of an industry whose record for outstanding service to the American public for more than a century has been without parallel.

There one may view the splendid progress of the advertisers whose cooperation constitutes the financial life blood of any publication of this nature. There too, one may trace the beginning and growth of the Boswell of the American Gas Industry, *American Gas Journal*.

Epilogue

GAZE up the years. One notes the gas industry still flourishing and drawing ever closer to perfection. Dimly ahead one sees gas the universal fuel, both in the home and in industry. One sees the present coterie of forthright gas executives—the MacBeths, the Foggs, the Gallaghers, the Paiges and myriad others—leading the industry to higher achievements than were ever dreamed of by their gallant predecessors of a day that has been crowded into antiquity by the march of time. And, let us earnestly hope, one discerns American Gas Journal *still young in vigor and, emulating the high standard of ethics and accuracy set by Callender and Dresser, still strong in faith and honor.*

"Strong in faith and honor"

Reminiscences

By ALFRED E. FORSTALL

Forstall, Robison and Luqueer

I HAVE been asked to prepare a series of articles reviewing the changes in, and progress of, the gas industry during the period of my connection with it, the request being based upon the assumption that this connection dates back as far as that of anyone still in active work in the business. Although this reason for my selection came somewhat as a shock, it is probably correct, since the connection can be said to have begun about sixty years ago even though it was an indirect one during the first ten years or so. This first installment will be devoted to the delineation of a background for what is to follow.

My father, Theobald Forstall, was forced to begin to support himself at an early age and without the advantage of a fully rounded-out school education. After showing the effect of the Yankee blood derived from his maternal grandfather, by turning his hand to various occupations, including keeping store in a small Minnesota town, and a tour of duty at the front in the Confederate Army, he finally obtained a position in his native city as book-keeper with the New Orleans (La.) Gas Light Company.

Value of Gas Papers

Being possessed of a laudable curiosity as to the details of all phases of any business with which he was connected, even though not directly related to his own duties, he at once began to "read, mark, learn and inwardly digest" the contents of the *American Gas Light Journal* and the *Journal of Gas Lighting, Water Supply,* etc., to which the company subscribed. Obtaining in this way a knowledge of the theory of the operation of gas works, he was ready to take advantage of an opportunity for advancement which soon presented itself.

The superintendent of the company became too ill to be able to attend to his work, but, hoping for his recovery, the directors looked for some one in the organization to assume, temporarily, the duties of the position. Because of the knowledge obtained through his study, my father was able to take on, and satisfactorily fill, the position of acting superintendent and upon the death of the former incumbent was made general superintendent of the company.

His ingenuity and resourcefulness were quickly tested. In the excavation for the brick tank of a new gas-holder quicksand was found just above the level of the tank bottom, and for a time it seemed almost impossible to complete the excavation and put in the concrete without pulling in much of the adjoining ground. A successful method was finally worked out and the installation was finished without damage to any adjacent structures.

Another item of plant enlargement was the building of a new coal shed and retort house. For the design and supervision of the erection of the iron frame of this structure, the company, on the advice of my father, engaged a man who was at that time regarded as a young gas engineer of great promise. Unfortunately, he proved inattentive to his duties, absenting himself without notice on fishing and hunting trips when his presence on the job was urgently needed. During one of these absences, while erection was in progress, the failure of one column caused the collapse of a large portion of the iron work already erected and the death of one or two workmen. The cause of the failure became a matter of dispute, the contractor claiming faulty design and the designer blaming it on faulty construction.

Elected a member of the American Gas Light Association at its second annual meeting in 1874, my father took a very active part in its work. Having been able, after the installation of the gas-holder mentioned above, to act on his conviction that, as far as possible, gas works operation should be avoided on Sunday, he ardently advocated this practice in discussions at meetings of the association. For many years in the New Orleans works, gas making was suspended on that day from 6 A. M. to 6 P. M. and the only men at work were those required to keep up the fires in the retort bench furnaces and to attend to other indispensable duties.

In addition to his participation in discussions he contributed in 1875 a paper on the "Proper Preparation of Lime for the Purification of Coal Gas"; in 1877 one on the "Advantage of the Removal of the Hydraulic Seal During the Distillation of Coal," and in 1880 one on "Stoppages in Ascension Pipes." All of these papers demonstrated the thoroughness of analysis and the carefulness in experimenting which he used in attempting the solution of the problems arising in gas manufacture. The first paper attracted wide attention both in the United States and in Europe and was characterized, in 1890, as probably the ablest paper read before the American Gas Light Association up to that time.

"Gas works operation should be avoided on Sunday"

My father's outstanding work for it led to his election, in October, 1882, as president of the association. His presidential address in 1883 dealt very forcibly with the increased cost of gas, and consequent extra expense to gas consumers caused by the conditions of competition between several gas companies which either existed at the time or had previously existed, in every city of any size in the United States. The burden of fixed charges on duplicate systems of street mains and of the costs of maintaining the organizations of several companies covering the same territory was stressed. The history of the gas business in Great Britain was reviewed in its progression from unlimited and ruinous competition, through the division of the territory into districts, each supplied by a single company, to the final profitable condition brought about by the merging of the many smaller companies into two or three larger ones having a monopoly of the supply of gas in their respective territories but under a sliding scale regulation of rates of charge and of dividends.

Effect of Competing Companies

Taking as a specifix example the City of New York, in which six separate companies were then operating with a seventh getting under way, my father calculated that the fixed charges on the excess capital involved by the duplication of works and street mains and the extra costs of operation as compared with a single company covering the whole city resulted in an extra charge of $1.00 per 1000 cu. ft. for the gas sold in the city.

He advocated combined and systematic action by the gas companies of the country to secure legislation embodying the following principles:

"1. Exclusive and obligatory supply secured to established companies.

"2. Initial price sufficient to earn 10 per cent upon the structural value of the plant, with sliding scale of prices and dividends.

"3. Purity and candle power regulated, and efficiently tested, with penalties for infractions.

"4. Annual publication of accounts."

Prompt action to secure this result was stated to be necessary because of the "recent organization of companies with the express purpose of compelling the adoption of patented processes in every town and city in the Union, whose agents place before the established companies the alternative either of paying blackmail or of submitting to competition."

While this address attracted much attention at the time, it did not lead to any action by the gas companies, but it is interesting to note that, except for the sliding scale, the four principles advocated, though then considered very heretical, are now embodied in gas regulation subject only to the modification brought about by changes in conditions during the past fifty years.

My father's intense interest in the subject can be understood when it is known that, to prevent competition, the New Orleans Gas Light Co. had been compelled to buy franchises granted to other companies and that, between his election as president and the delivery of his address, he had gone from New Orleans to Chicago to take the position of general manager of a gas company which was facing the competition of another company just getting into operation.

The Chicago Gas Light & Coke Co., the established coal-gas company, supplied gas to the North and South Sides of the city. The West Side was supplied by the Peoples Gas Light & Coke Co. The Consumers Gas Co., organized to manufacture and sell carbureted water gas made by the Lowe process, confined its activities to the territory of the Chicago company. This competition, beginning in 1883, was soon accentuated by the organization and going into operation of the Equitable Gas Co. using the Jerzmanowski process for making gas. The franchise for this company was granted to the political bosses who controlled the Chicago City Council and was sold by them to the New Yorkers who owned the patent rights for that process for the manufacture of carbureted water gas.

Gas Stock Acquired

Tiring of the costs and loss of profits entailed by this competition of three companies in the same territory, an agreement was reached under which the stock of all three companies was acquired by the Chicago Gas Trust, the companies retaining their separate organizations with a co-ordination of their operations.

The board of directors of the Gas Trust was divided into two antagonistic groups, one representing the Chicago and the other the New York interests, with the latter gradually securing control. As a result of the conflict between these groups the position of the executives of the old Chicago company was a very trying one and my father's health, far from robust at best, was broken down and he died in January, 1890, at the age of fifty-three.

From this biographical sketch of my father it can be seen that from an early age I lived in a gas business atmosphere. In addition he disliked traveling alone so when in 1872 he had occasion to take a trip covering Chicago and various towns in Ohio, Minnesota and Wisconsin, and it was impossible for my mother to accompany him, I was taken as his companion. As an eight year old boy I thus sat in during the sizing up of the engineer being considered for the work of designing and supervising the erection of the proposed coal shed and retort house, and at interviews with Mr. Harvey Rand for the discussion of the desirability of the Gale and Rand gas process for use in New Orleans.

First View of New York

Again in 1874 when it was necessary for my father to come to New York to settle with the Architectural Iron Works the disputed questions concerning the responsibility and liability for the collapse of the retort house frame during its erection, I was taken along for company and saw New York for the first time. How I amused myself in the office of the Iron Works, while the disputed points were discussed and an agreement reached, has now been forgotten. I know, however, that time did not "hang heavy on my hands" and that the trip was a very interesting one. It is recalled each time that I pass through Union Square, since on the corner on which then stood the Union Square Hotel, in which we stopped, there still stands an hotel, the New Union Square, which, in spite of the addition of "New" to the name, looks as if it might be occupying the same old building.

Once more, in 1878, I was the companion of my father on a trip, this time to Ireland, England and France, during the course of which he attended the annual meetings of the English and French gas associations, and I met several English gas men and also some from the United States, including Geo. Warren Dresser, then editor of the *American Gas Light Journal,* and Malcolm S. Greenough, of Boston.

During our stay in England a visit was made to Maidstone to see, at the gas works there, Mr. John West and the retort charging and discharging machines which he was then developing.

The meeting of the French gas association followed immediately that of the English one and a large

(Continued on page 144)

Changing Requirements for City Gas Quality

By R. S. McBRIDE

Consulting Editor,
American Gas Journal

QUALITY of gas has often been almost as important a subject as price, both to companies and their customers. An appreciation of this has, however, grown slowly. In the early days of the industry the general attitude toward gas quality seems to have been to take what came from the retort or generator and market it, almost "as is." That situation, of course, has not prevailed for many years past. But in historical perspective, one gets a keener appreciation of how great a change in attitude has taken place.

Early Standards

The original method of manufacture was by the retorting of coal. Only by selection of the coal and modification of the processing could the manufacturing department materially affect the quality of the send-out. In those days most of the gas was used for lighting, principally in open flame burners. Hence it was natural that the candlepower of the gas should be regarded as a proper measure of its quality.

Tests of candlepower were made largely by producing companies for their own information, as a guide to the maintenance of uniform service. However, during the middle of the 19th century the question of the quality of the gas took on public interest. Legislation and regulation began. Massachusetts was a pioneer in this effort. As early as 1861 that state had a statute requiring gas companies to supply their customers with gas which tested 16 candlepower. That, in the opinion of the writer, was the first legislative effort to give state-wide official supervision.

Few other state regulations affecting candlepower were ever adopted. New York state did have for second-class cities, candlepower requirements of 16, 18, or 20 candlepower, prescribed according to whether the gas was coal gas, mixed coal and water gas, or water gas, respectively. Maryland authorized its public service commission to fix standards but continued in effect for a time old candlepower rules, especially for Baltimore and Easton. In both cases 20 candlepower was prescribed. Ohio by state law did fix a minimum of 12 candlepower for artificial gas; but this limit was so low that it was rarely an important factor governing the supply of gas.

City Ordinances

Municipal ordinances, often parts of franchises giving authority to operate, were much more frequent, very much more severe. Several of the largest cities of the country, notably New York, Philadelphia, and Chicago, required as high as 22 candlepower for the gas delivered within their borders. Between 40 and 50 other municipal governments had like rules ranging in severity from 14 candlepower to 23 candlepower, this latter required "at the works" in Omaha. Substantially all of these municipal regulations continued in force until about 1910.

Controversies over these municipal requirements were frequent and it was not uncommon that the municipal testing official and the company employees were in conflict as to the interpretation of rules, method of testing, or actual correctness of experimental results obtained. Almost as much bitterness centered around these differences at times as was encountered in cases involving the fixing of rate schedules.

Wisconsin Pioneers

Shortly after the founding of the Wisconsin Railroad Commission with authority over public utilities, by law passed in 1907, that state took an entirely new view of gas quality regulation. The members of the commission guided by far-seeing technical men, became convinced that the heating value of gas was more important to the customer than candlepower. This was unquestionably true even in those days for the vast majority of the service, since open-flame lights had already largely been replaced by mantle lighting, and cooking and waterheating as important household uses had begun. At that time it appears likely that less than one-third, probably less than 20 per cent, of the gas was used in open-flame lights where candlepower was of significance.

The Wisconsin commission decided to do something about this situation. They organized a technical committee to determine facts as to conditions prevailing in the state. This committee worked with the active sincere cooperation of the companies, having the valuable services of Mr. R. B. Brown, then engineer of Milwaukee Gaslight Co., the late William J. Huddle, chief gas engineer of the commission, and Dr. C. F. Burgess, then professor of chemical engineering at the University of Wisconsin. These men made a clean-cut technical study and reported that under most conditions within the state the gas then supplied averaged about 600 B.t.u. per cubic foot in "gross" heating value.

Thus there was established an intelligent basis on which to determine what the customers were then getting, what was giving satisfaction. As a result the state commission adopted in 1908 as one of its rules the requirement that gas supplied to customers should be maintained with a monthly average heating value of not less than 600 B.t.u. per cubic foot and with a minimum heating value never below 550 B.t.u. This was destined to become an outstanding decision guiding the practice of the industry and regulatory effort for the following decade. That the facts gathered were dependable and the choice wise was amply demonstrated later through country-wide experience.

Standard Test Methods

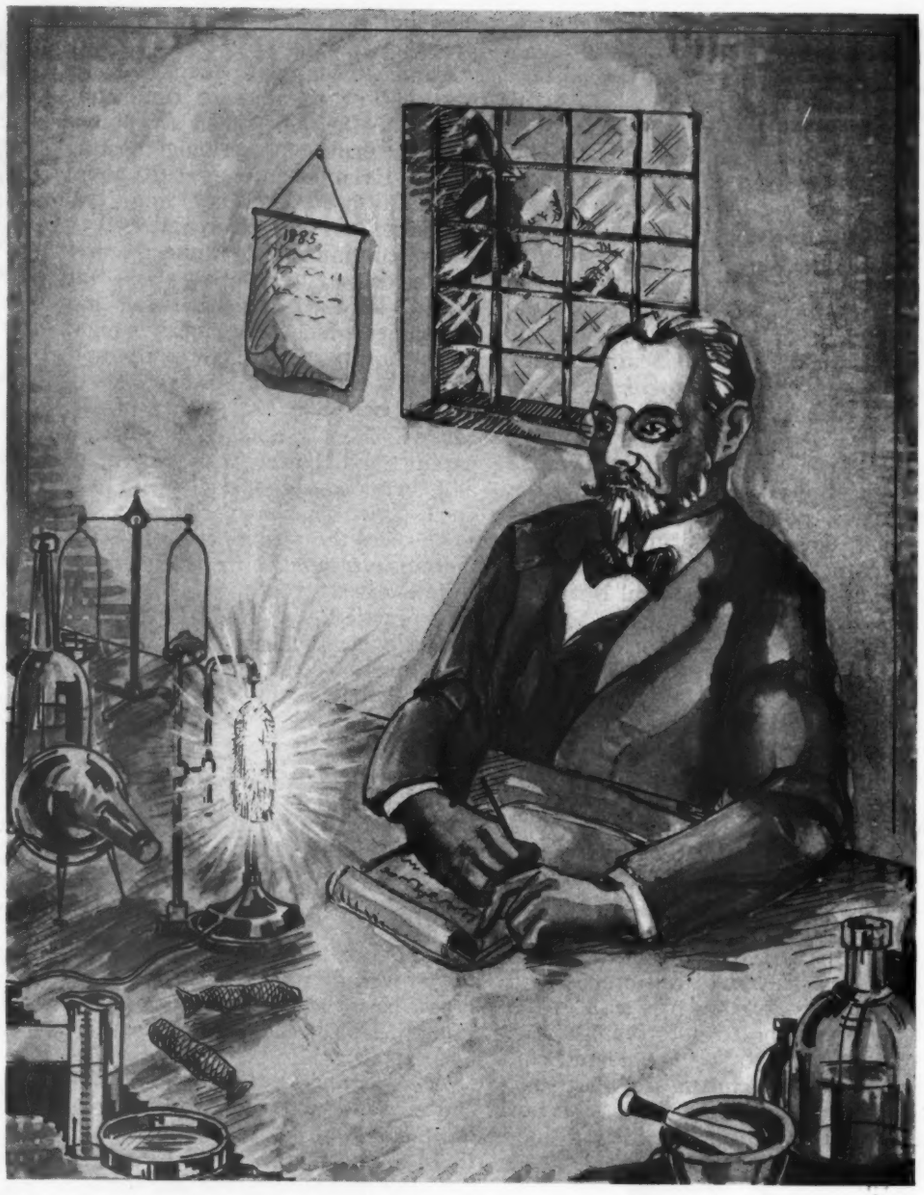
By 1908 it had become evident throughout the country that test procedures were subject to many uncertainties. Outstanding executives of the industry working through American Gas Institute decided that something should be done about

this. They asked Congress to provide for the Bureau of Standards a small appropriation permitting a fundamental study of standard methods for the testing of candlepower and heating value of gas. This investigation was initiated on July 1, 1909.

At that time fundamental investigations in the photometric laboratories were undertaken in the hope of fixing flame standards which could be used in gas photometry. Simultaneously in the heat division of the Bureau a study of gas calorimeters began. Two quite distinct, and perhaps altogether unexpected, results developed.

1. It was very soon discovered by those engaged in the candlepower investigations that their work was extremely difficult and perhaps misdirected. The mere fixing of standard methods of testing and the establishment of standard lamps as a basis of gas comparisons was believed by the Bureau to be inappropriate without a knowledge of the purposes to which these devices and methods were to be applied. An investigation on that latter phase of the subject soon disclosed that work of this character was likely to perpetrate uneconomic unsound methods in the fixing of standards for utility service. From that conclusion grew one of the outstanding developments in quality control.

2. The calorimetric investigations made it evident that much of American practice was extremely at fault. Uncertainties, if not errors, as great as 10 or 15 per cent, were frequently encountered in commercial practice. It was soon disclosed that only one or two types of instruments in use anywhere in the world were worthy of serious consideration for American use. The study proved very difficult and protracted; but out of it came calorimetric practice that even today is thoroughly dependable, internationally accepted.



Auer von Welsbach, by reason of his development of the incandescent gas mantle in 1885, gave a great impetus to lighting by gas.

Exit Candlepower

As indicated just above, the candlepower studies suggested that perhaps work of this sort was misleading in its commercial and social implications. The Bureau, therefore, made a country-wide survey as to the best judgment of officials, gas companies and competent technical men generally. The judgment was rapidly becoming unanimous that testing of gas for city supply on the basis of candlepower specifications was needless or even misleading. There was, therefore, carried out in the period from 1910 to 1912 an extended study of new standard regulations for manufactured gas and gas service which led to the publishing in April, 1912 of the first edition of the famous Bureau of Standards Circular No. 32. That document formally entitled "State and Municipal Regulations for the Quality, Distribution, and Testing of Illuminating Gas" never went by this dignified title. It became so widely known, one might say so infamous, among gas men, that it went by the familiar nickname "Circular No. 32." And any gas man knew what you were talking about when you mentioned it in that fashion, even if you made no reference to the Bureau of Standards.

Shift to Heat Value

From the first year of its inquiry, the Bureau of Standards recognized, and consistently stated in print, that a heating value standard was a superior measure of the quality and usefulness of gas supply. It therefore urged the adoption of heating value standards throughout the country, and began expressing preference for state commission regulation rather than municipal ordinance control. However, there was for the industry a very large fly in this welcome ointment. The Bureau said on numerous occasions that the abandonment of candlepower standards, though highly desirable, should not occur without due consideration to

the significance in possible curtailment of service afforded.

This, of course, meant that in several of the largest cities where high-candlepower standards had existed the Bureau suggested the propriety of answering an embarrassing question—Will the customers not receive much less useful service per thousand cubic feet if an appropriate heating value standard be substituted for high candlepower regulations without change in price? It was the introduction of this element of price adjustment which caused most of the subsequent difficulties.

State commissions were springing up throughout the country in imitation of the very successful early state agencies, notably imitating the far-seeing developments in Wisconsin. Even the authority of commissions, such as the very successful Board of Massachusetts, was modified to give the official greater authority for adjustment of technical detail. All of this tended to increase rapidly the use of state rules. And as these state rules developed, the suggested general forms of the Bureau of Standards were widely adopted.

It is a matter of interest to note that from 1909 to 1918 there was fixed by state agencies of the United States only one set of state rules which had not been *before adoption* the subject of correspondence, discussion, or extended conference with the Bureau of Standards staff. It is also interesting to note that the one set of rules not so considered imposed on the companies of that state restrictive measures impossible of enforcement, absurd in their technical phrasing and significance.

The Price Question

Throughout this period of 10 years the Bureau of Standards consistently refused to make any recommendations as to what was the proper price for gas, usually even refraining from saying what was a proper heating value standard for any particular circumstance. Only in a few cases after an extended field study, participated in by both public officials and company officials, did the Bureau make definite recommendations as to what numerical values should be inserted with respect to heating value.

So dominant was the influence of the early Wisconsin work that almost universally throughout the country the standards came to be 600 B.t.u. monthly average heating value, 550 B.t.u. minimum. Again it is worthy of note that the wisdom of the Wisconsin method of investigation was clearly evidenced by the widespread acceptance of the findings and successful imitation of the precedent there set.

Candlepower requirements did not pass out of the picture completely even with the widespread acceptance of state rules prescribing heating value. Even as late as 1920 there were still in force over 40 municipal regulations of this character.

The continuance of these requirements, especially during the war period, imposed difficulties on gas companies which they rightly sought to ameliorate. One method attempted, imitating English practice, was to use a burner in the testing of the gas which gave a much higher apparent candlepower than that actually obtained in service with the open-flame or fishtail burner. In some cases the rating of the gas was thereby increased 3 to 5 candles, in a few cases even more than this. This practice, of course, aroused certain criticism; and much controversy was inevitable in the communities where candlepower standards continued.

The matter became so acute that just before this country entered the World War, executives of the industry took cognizance of it, proposed to draft resolutions fixing as the standard practice of the industry the use of the most favorable types of test burner. This movement, a desperation gesture to save a few companies, proved by its secondary effects a great blessing. The full story of events has probably never before been made public.

American Gas Institute officials concerned with this matter were to meet for final action on the resolutions fixing as the standard burner the Metropolitan Argand Burner No. 2, the British test burner found most favorable, for low candlepower gas giving the highest test rating. This action seemed, to the technical men who had been investigating these matters at the Bureau of Standards, contrary to the best interests of the industry. The Bureau, therefore, took the most unusual course of stating to these Institute executives the proposed policy for later Bureau action.

This was, in effect, of two parts, based on two assumptions. The Bureau said if the industry would abandon its advocacy of an artificial testing procedure, then the Bureau would exert every influence which it properly could extend for the repeal of existing candlepower standards and the fixing instead of appropriate heating-value standards. This, the Bureau believed, was a proper and necessary relief for the interested companies. As an alternative the Bureau said that if the industry continued officially to advocate an artificial, and in the judgment of the Bureau, improper, test procedure, then the Bureau should abandon all of its efforts in the direction indicated and merely reserve its action in candlepower cases to the recommendation of the open-flame test burner.

The resolution was not adopted. The Bureau carried out its part of the agreement and worked zealously for the cancellation of the candlepower standards in many communities. Despite this effort there was, as above stated, a hangover of 40 or more local municipal ordinances even as late as 1920. Those, however, were almost altogether in small communities or merely nominal requirements not seriously handicapping local companies. Few were higher than 16 candles, a figure then about corresponding to the prevailing 600 B.t.u. practice.

Technical Trends

All of this detailed history had far greater meaning than local controversy. The early adoption of candlepower rules was natural. The advancing of the candlepower standard higher and higher until some communities actually were served with 25, 27, or even 30 candle gas, was a secondary effect of the competition between water gas and coal gas. Proponents of the water gas process, seeking every advantage over their coal gas competitors, promised municipal authorities high candlepower supplies even up to the point of very uneconomic results. There is more than a suspicion that certain oil companies anxious to dispose of gas oil, then a drug on the market, were not a negligible factor in these trends.

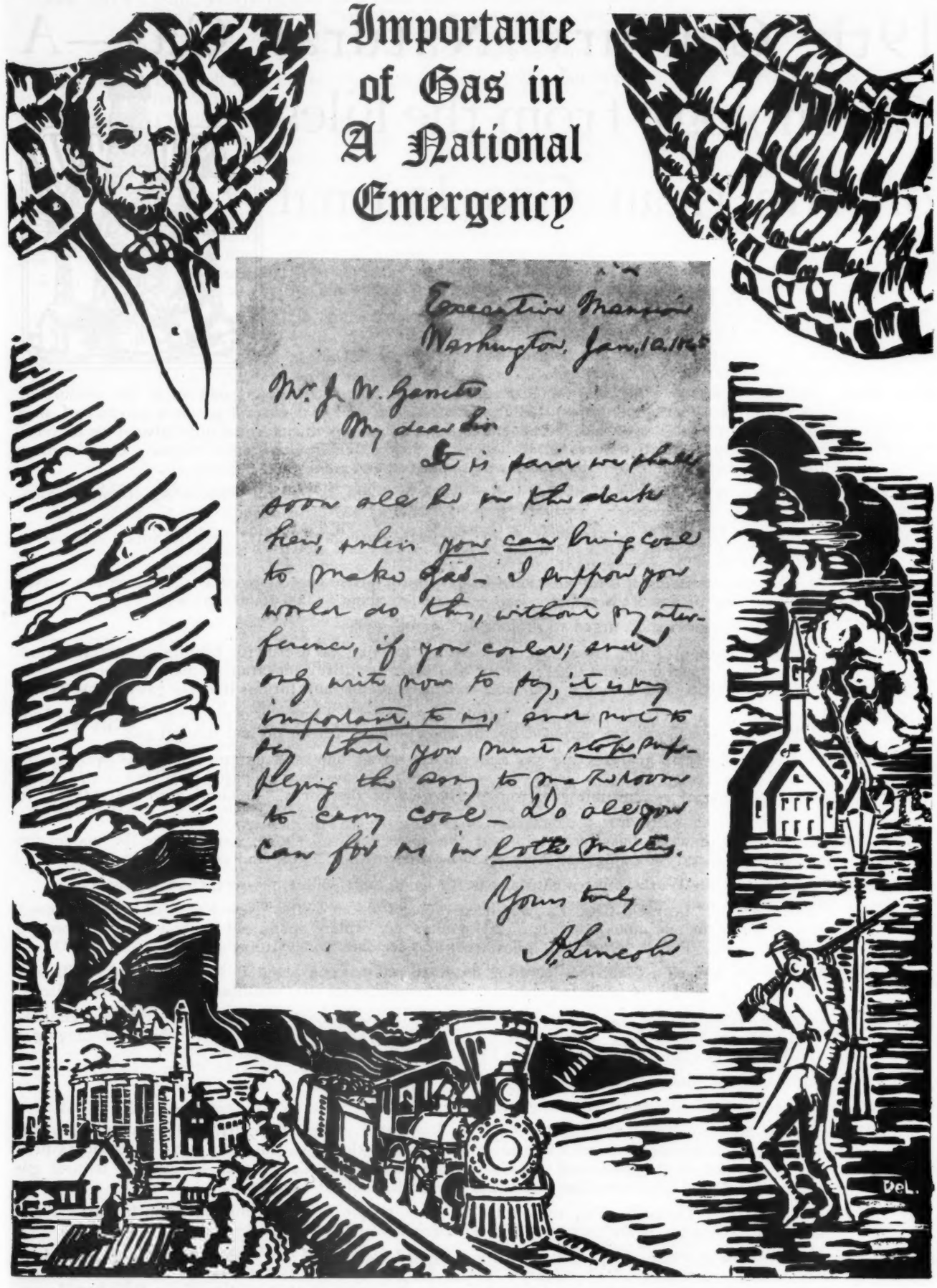
As gas oil became more expensive and, as a result, more costly, an appreciation of the difficulties of supplying satisfactory service with too rich gas was reached. These efforts to establish high candlepower practices were abandoned.

More recently the entry of natural gas into municipal supply where manufactured gases alone were sold before, has renewed the trend to higher heating quality. All are aware of the discussions in Denver, Chicago, and elsewhere, in which substitution of either mixed-natural or all-natural supplies made necessary the establishment of 800 B.t.u. standards or even higher. In these cases, however, rate adjustments were presumed to be essential, and were a natural consequence of the radical change in setup contemplated.

At this point the "therm" entered

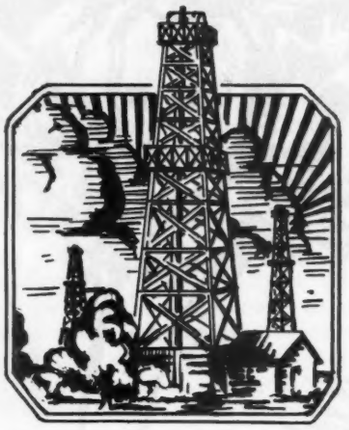
(Continued on page 144)

Importance of Gas in A National Emergency


Executive Mansion
Washington, Jan. 12, 1863
Wm. J. W. Garrett
My dear Sir
It is said we shall soon all be in the dark here, unless you can bring coal to make gas. I suppose you could do this, without my interference, if you could; and only write now to say, it is very important to me, and not to say that you must stop the people flying the carry to me Rebellion to carry coal. Do all you can for me in both matters.
Yours truly
A. Lincoln
DeL.

A Wartime Letter from President Lincoln to President Garrett of the B. & O. R.R.

19th Century Natural Gas—A Chronology from the Files of American Gas Journal



By J. FABER HANST, E. M.

Oil and Gas Engineer, Chicago Pneumatic Tool Company

Sept. 1861 Prof. E. B. Andrews, of Marietta College, advances the theory that crude oil is the product of distillation, at low temperatures, of bituminous strata, and that natural gas is a product of such distillation. He also says that the oil and gas accumulations thus formed must always be in vertical, or nearly vertical, fissures in the rocks, and cites numerous instances to prove that the more broken the strata, the better the chances of finding oil and gas.

Nov. 1862 Natural gas is used in the Kanawha Valley, West Virginia, as fuel for evaporating salt water coming from the same wells.

Mar. 1884 Well near Erie, Pa., gives 20,000 cu. ft. of "perfectly pure gas per day" believed much superior to manufactured gas.

Nov. 1864 Dr. Rowell makes the first application of gas lift for producing oil from a well which has ceased flowing. Cost of gas wells 600 ft. deep estimated at about $6,000-$6,500 per well.

June 1865 Natural gas conservation urged to prolong life of oil wells.

May 1866 First glimmerings of the knowledge that natural gas may be useful for heating and lighting purposes. An editorial mentions the "fantastic and often beautiful appearance" made by the flames in Petroleum Center and Tidioute, Pa., and comments on the multifarious uses for gas in those towns.

July 1867 Westfield, N. Y., recently completes "natural gas works." Comment is made on how the peat beds of Western New York are enriched by the absorption of petroleum and natural gas.

Mar. 1870 Prof. Henry Wurtz analyzes the gas and reports on a "new and extraordinary gas well in the state of New York." Having visited the well himself, he says he is prepared to believe in the "enormous evolution of combustible gas from the bowels of the rocks," amounting to 400,000 cu. ft. per day.

Apr. 1870 The *Journal* predicts that Rochester, near the above gas well, should soon become the "model city of the world," and intimates that the gas can be used in the "simple and entirely safe gas-engine."

June 1870 Erie, Pa., Water Works utilizes natural gas for firing their boilers, saving $8 to $10 per day.

July 1870 "Burning Well" near Oil City, Pa., has been raging for four years. New well drilled near it comes in with gas at the enormous pressure of 200 pounds per square inch, and engines are run on gas pressure alone. People come from miles around to see this wonderful achievement.

Sept. 1870 Natural gas is used as fuel for operating crude-oil stills at the plant of Messrs. Busseck, Clark & Co., Erie, Pa., and it is predicted that this will revolutionize the "manufacturing business of Erie."

Nov. 1870 Erie, Pa., lighted by natural gas, and Fort Scott, Kans., contemplates doing likewise from a well making 10,800 cu. ft. per day. Bloomfield, N. Y., Natural Gas Co. advertises for bids for digging a trench to lay gas lines from their well to Lima, a distance of seven miles.

June 1871 Buffalo, N. Y., drills gas wells for city use.

Aug. 1871 Painesville, Ohio, discovers natural gas.

Apr. 1872 Gas line laid from West Bloomfield, N. Y., to Rochester. Great difficulty in maintaining adequate flow, due to faulty construction. Consumers complained that gas was not equal to manufactured gas as supplied by the Rochester Gas Co. and Rochester Gas Co. refuses to use the natural gas piped to the city, thus wrecking the hopes of the Bloomfield Company.

July 1872 Gas well near Titusville, Pa., runs wild, so that "people in the vicinity are much alarmed and cattle run about the fields perfectly wild with fright."

Nov. 1872 Entire house at Painesville, Ohio, heated and lighted by natural gas from a well "large enough to supply the entire city of Cleveland." Observers report that the "roaring of the flames under a full head of gas was awfully grand." A further article states that the gas wells at Erie "now number twenty-five." Wells are now being drilled at Cleveland and Conneaut, Ohio.

Feb. 1873 Prof. Wurtz refuses to become martyr to ridicule by having advocated the use of natural gas for the manufacture of "lampblack," even though a Mr. Howarth, of Boston, is cited as being a successful manufacturer of such a product from one-twelfth of the gas from a well near Cumberland, Md. The start of the carbon black industry.

July 1873 Gas well near Butler, Pa., with pressure of 250 pounds per sq. in., is "a great curiosity in the neighborhood."

May 1874 Charles Plagge presents a scheme to keep the Erie Canal open all winter by utilizing natural gas as a heating agent to heat the water in the canal. He also proposes to use "fireless tugboats, operated by superheated water." The *Journal* advocates, editorially, intensive exploration of New York state, "from Lake Erie to the Catskills" to open up new gas fields, estimating that the state contains an area of 12,000 square miles favorable to development.

June 1874 The *Journal* speculates on the enormous benefits which would accrue to New York state if it were possible "to tap and draw from stores of gas pent under the Catskill range, conduct this gas to tidewater," and do all manner of things with it. It is stated that it is not a hoax, but an actual fact, that iron is being made at Leechburg, Pa., by the use of natural gas, "which is worth $10 to $20 per ton more than that made with coal, and the quantity is one-third greater!"

July 1874 Gas found at Iola, Kans., no good for illuminating, as it would only give a light equal to 2¼ candles.

Sept. 1874 Gas discovered at Mattoon, Ill., in a well drilled for water. "The air was filled with a stench for several days as the malodorous fluid came pouring out in a seemingly exhaustless volume, but at the suggestion of one of the many hundreds who had been attracted to the spot, a wisp of lighted straw was applied to the current, and, very naturally, in a few moments the air was purified, but the contact of fire with the rushing gas resulted in a loud explosion which startled the neighborhood." The Lord sure took care of the children and fools on that occasion, as nothing was said of any damage being done to spectators or property!

Nov. 1874 The Erie Rolling Mill also uses gas for fuel in making iron.

Mar. 1875 It now appears that gas from a well near McCoy's Station, Pa., has been used since 1865 for making "lampblack," 45,000 cu. ft. per day having been utilized during that period.
A burning well near Butler, Pa., gives off so great a heat that trees start budding and the grass is green, even in mid-winter. Visitors state that "the scene was beyond description."
Salt well near Mercer, Pa., having been capped and abandoned, blows up with a loud report. Well was then purchased by a man who proposed to build a flour mill to be run by the gas from the well.

May 1875 Old salt well drilled in 1820, near Sciotoville, Ohio, reopened and used for gas by Scioto Firebrick Co. Well had produced petroleum and natural gas since 1820, but no one knew what to do with it.

June 1875 Great activity in the Pittsburgh, Pa., district drilling for gas. An eight-mile line is actually proposed to supply gas to Pittsburgh.

Oct. 1876 Gas used at Etna, near Pittsburgh, is almost discarded from use because the pressure dropped from 80 pounds at the well to 17 at the furnace. Apparently, no one had yet thought of compressors.

July 1878 Reference made to the defunct Bloomfield and Rochester Gas Company, by the discovery of some old stocks and bonds among the effects of Harry Beadle, banker, of Elmira, N. Y.

Oct. 1878 Use of natural gas as the ideal fuel is growing. Harmony, Pa., runs practically the whole industry of the town with it. It is stated as a remarkable feature that natural gas may be breathed just like air, without any ill effects, while manufactured gas is actually dangerous to inhale.

Nov. 1878 Kansas City, Mo., expects soon to be lighted with natural gas from wells at Wyandotte.

Apr. 1880 Mr. McDougall, of Hornellsville (Hornell, N. Y.), reads what is probably the first paper on natural gas presented before a convention—that of Central New York Gas Engineers Association, held at Rochester, N. Y., February 19, 1880.

Dec. 1881 Natural gas discovered in Cincinnati, O., causing a sensation in that city.

May 1883 A 6,000,000 cu. ft. gas well is brought in near Greensburg, Pa., for which the owners have been offered $20,000.

Sept. 1883 Mr. A. P. Wilson, of Pittsburgh, Pa., through the columns of the *Journal*, predicts that the most productive territory for natural gas will be an area about 80 miles wide, extending from Lake Ontario, and ending at the Kanawha River in West Virginia, and that a continuation of this belt, but much narrower, will be found through Kentucky and Tennessee into Alabama. Sections of Wisconsin, Michigan and Illinois are also listed as favorable territory by Mr. Wilson.

Nov. 1883 Fredonia, N. Y., area being drilled again with slight success.

Dec. 1883 The Mt. Vernon, Ohio, Natural Gas Company is incorporated.

Jan. 1884 Many more natural gas companies being incorporated in Western Pennsylvania. At the same time, report is made of a huge gas well in Washington County, Pa., running to waste for two years, burning continuously. A company has been formed to pipe this gas to Monongahela, 25 miles distant.

Apr. 1884 Bitter legal contest between companies supplying Pittsburgh, Pa., with natural gas is finally ended when Judge Stowe decides in favor of the "Fuel Gas Company," thus giving this company "exclusive rights to supply Pittsburgh until they have paid five 8% dividends."

May 1884 Natural gas near Wheeling, W. Va., to be used for glass manufacture.

Aug. 1884 Natural gas discovery reported in Frankfort, Dakota Territory, at depth of 85 feet.

Sept. 1884 Washington, Pa., regularly supplied with natural gas for heating purposes.

Oct. 1884 Mr. John C. Hastings, secretary and treasurer of the Washington, Pa., Gas Light Co., gives data on prices to consumers in his territory. Gas for an "ordinary family size cooking stove" costs $12 per annum for each stove, "hotels and extra large ranges, of course, costing somewhat more." Grates and heating stoves in private dwellings, "where the supply is kept up the entire year," cost $8 per annum each. If the supply were required only part of the year, then a charge of $1 per month was made for the first stove and $0.75 for each additional one. Mr. Hastings said that the inhabitants thought these prices entirely too high, and as a consequence, the Citizens Natural Gas Company was formed to drill wells and supply gas to the town.

Nov. 1884 The *Journal* publishes the first comprehensive convention paper on Natural Gas, delivered by Mr. C. E. Hequembourg of Bradford, Pa., before the 12th Annual Meeting of the American Gas Light Association.

In this paper, the first mention is made, of which the *Journal* has record, of compressors being used to pump gas through pipe lines. Mr. Hequembourg mentions a pump station near Bradford, Pa., of 580 h.p. which was used "in extreme weather," to increase the flow. However, this did not elicit any comment or discussion, although the members went to great length to discuss the illuminating power of the gas.

Dec. 1884 Price of natural gas at Pittsburgh reduced from $0.40 to $0.30 per M.C.F., a further discount of $0.10 per M.C.F. being allowed for prompt payment. The *Journal* comments that this ought to be cheap enough to satisfy anybody.

Jan. 1885 The *Journal* reports on Oil and Gas Wells of Pennsylvania, quoting a paper by Mr. T. J. R. Seaver in "Engineering," a British publication. Mention is made of the monster 3,600 bbl. oil well near Butler, Pa., and the intense activity in the vicinity of Pittsburgh in drilling for gas to supply the steel mills, glass works, and other industries.

Feb. 1885 Drilling for gas at Ironton, Ohio, without much success.

Apr. 1885 Mr. Irving Butterworth of Columbus, Ohio, reads paper on Natural Gas, at the First Meeting of the Ohio Gas Light Association. In it, the first suggestion is made of odorizing natural gas, to assist in its detection from leaky pipe lines, principally because of the danger of explosions, which by then had become quite prevalent.

July 1885 Every iron and steel mill in Pittsburgh, Pa., using natural gas as fuel. Associated Press says it will cut consumption of coal 38,250,000 bushels per annum and throw thousands of men out of work. The *Journal* thinks "the picture is somewhat overdrawn."

Aug. 1885 The *Journal* publishes in full the first really comprehensive paper on Natural Gas, delivered by Mr. Emerson McMillen before the 8th Annual Meeting of the Western Gas Association.

Sept. 1885 Mr. J. M. Critchlow's paper on Natural Gas, at the 8th Annual Meeting of the Western Gas Association provokes great discussion as to the permanency of the natural gas supply, many noted experts claiming that it could never be a serious menace to the manufactured gas industry.

Pittsburgh Plate Glass Co., at Creighton, Pa., is operated entirely on natural gas as fuel.

Cleveland Rolling Mills, Cleveland, O., drills to 2,700 feet in search of gas.

Natural gas is discovered in Canada, in a shallow well in Point-aux-Trembles township.

Beaver County, Pa., is the scene of several new "roarers," as natural gas wells are brought in and a company is formed to serve Rochester, New Brighton and Beaver Falls, Pa.

Nov. 1885 The Pittsburgh Commission on natural gas makes its report and decrees that high pressure gas should not be permitted within the city limits. Recommendations are made regarding the installation of governors, gauges, and suitable pipes for distribution within the city.

Toledo, Ohio, develops small gas field at depth of 1,500 feet.

Dec. 1885 W. H. Denniston reads paper on natural gas at the meeting of the American Gas Light Association, and half-jokingly suggests that before long Western Pennsylvania may be supplying "gas to Chicago and the West as a cheap substitute for corn-cob fires."

Capitalists seriously consider building a gas line from Western Pennsylvania to seaboard.

Over 500 miles of pipe have been laid in and about Pittsburgh to date, some as large as 24 inches. It is even whispered that certain interests are preparing to build a pipe line 200 miles long to bring gas to Cincinnati.

First mention is made of the possibility of metering natural gas.

It is also predicted that "within five years there will be some town in every state in the Union lighted by natural gas."

The gas men are just beginning to wake up to the fact that natural gas is developing into a tremendous industry.

Findlay, O., booming as a result of having a supply of natural gas available.

Feb. 1886 Drilling for gas at Homewood, Pa., reaches a depth of 6,000 feet.

May 1886 Indianapolis, Ind., awards contract to drill for natural gas.

Aug. 1886 The *Journal* publishes Mr. Emerson McMillen's paper on the "Flow of Natural Gas." This is the first serious study of the question, but the idea of building long pipe lines is more or less ridiculed by Mr. McMillen because of the cost of and size of pipes required. No thought apparently has yet been given to compressor stations.

Sept. 1886 East Liverpool, Ohio, potteries again being fired with natural gas piped from West Virginia.
Prof. Orton, state geologist of Ohio, publishes his paper on the Oil and Gas Fields of Northern Ohio, outlining what he considers favorable areas for exploration.

Dec. 1886 The *Journal* publishes "Soem Further Remarks on Natural Gas," by Mr. Denniston, who warns the manufactured gas industry that they will have to reckon with natural gas in the future, whether they like it or not.

Jan. 1887 A company is formed by popular subscription to pipe natural gas to St. Louis, Mo., from Edwardsville, Ill., a distance of 30 miles.
The *Journal* publishes a digest of a lecture on natural gas by Mr. Chas. A. Ashburner, Pennsylvania state geologist, in which it is stated that there was no immediate danger of exhaustion of gas supplies, especially in the vicinity of Pittsburgh, Pa.

Aug. 1887 The *Journal* publishes Mr. Denniston's paper on "Enriching Natural Gas," in which the first mention is made of the "new Welsbach burner."

Apr. 1889 Prof. Lesley, state geologist of Pennsylvania, states that in his opinion the natural gas supply is nearing exhaustion and that the young people of his day will surely see the end of it.
Philadelphia Company, at Pittsburgh, Pa., places all its service on meters.
Much alarm among gas men over the decline of natural gas in the Ohio Valley.

May 1889 Deep gas wells disprove the former theory that natural gas cannot be found below sea level.

Aug. 1889 E. A. Cook, of McComb, Ohio, patents a device "to increase the fuel and illuminating capacity of natural gas from gas wells, by injecting *air* into said wells in sufficient quantity to make it intermix with the natural gas therein and impart to said gas sufficient pressure and volume to cause the same to flow readily from the well." He claims that his device will "certainly quadruple the force flow of any existing light pressure well."

Jan. 1890 Prof. Orton comments on the origin of rock pressure in gas wells, and speaks of "pressure of 420 to 480 pounds per square inch" being the average in the Wood County, Ohio, field. He also mentions that in some few cases higher pressures had been recorded but that the "existence of these incredulous pressures was short-lived."

Feb. 1890 Mr. Chas. Harrison writes on the "Financial Aspect of Natural Gas" and states that "All natural gas stocks are speculative" and . . . "have never risen to the dignity of legitimate investments, and *there is no prospect that they ever will.*" What an opportunity he missed! He also says that "with constantly and inevitably increasing cost of production and no opportunity for a corresponding cost to the consumer, what is to prevent ultimate bankruptcy of every natural gas company?"

June 1890 Mr. James Somerville falls in line and predicts the end of natural gas "in a few years at most."

Aug. 1890 Coal is beginning to displace natural gas at Pittsburgh steel mills, due to uncertainty of the gas supply.

Jan. 1891 It is now established that natural gas is to be sold on a metered basis and that the day of unlimited gas at a flat rate is over, forever.

Feb. 1891 The Pitot tube is advocated for natural gas measurement.

Nov. 1893 "The largest gas well in the world," the Swagler No. 1, is brought in 12 miles east of Washington, Pa. Its roar was heard for 15 miles.

Sept. 1894 Several unsuccessful attempts are made to find oil and gas near Philadelphia.

June 1896 State Geologist Blatchley, of Indiana, reports that one-half of the natural gas in the state has been exhausted.

July 1896 Mr. Joseph Deveeks, of the U. S. G. S., reports that the total value of the natural gas consumed in the United States in 1895 was $13,006,750 as compared with a value of $13,954,400 in 1894 and $14,346,250 in 1893. It is significant to note that the natural gas consumed in Texas was $50 in 1893, $50 in 1894 and $20 in 1895. The values of natural gas consumed from 1882 to 1895 show a rise from $215,000 to $13,006,650, with 1888 as the banner year, when $22,629,875 worth was used.

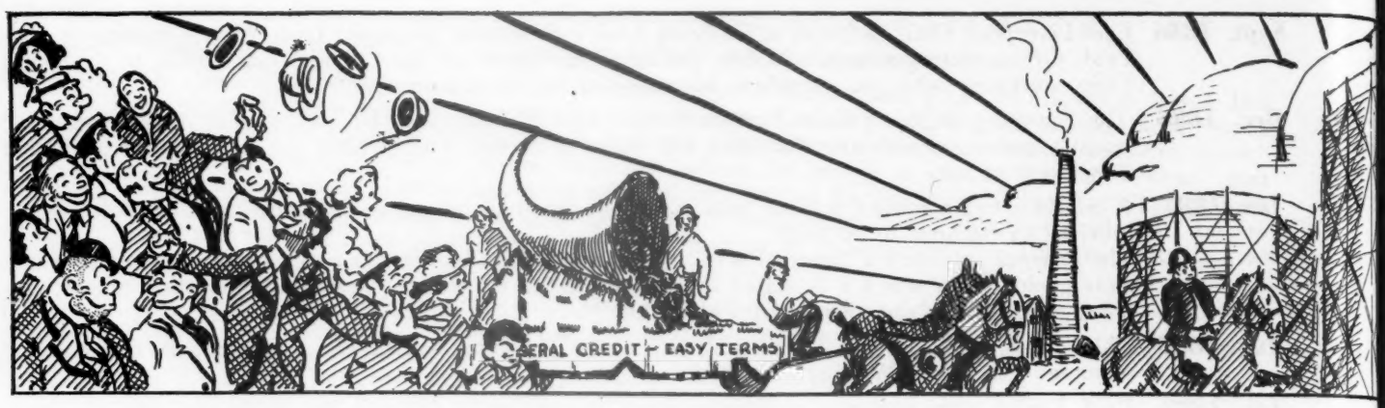
Aug. 1897 Salt Lake City, Utah, change-over from manufactured gas to natural gas is described by Mr. John Kempf, Jr.

Sept. 1897 The report of the U. S. G. S. for 1896 marks the first mention noted in the *Journal* of the use of compressors for pumping natural gas. Value of the gas used in 1896 drops to $13,002,512.
The U. S. G. S. also makes a direct comparison of the heat values of coal, oil, and natural gas and reaches the following conclusions:

10 cu. ft. natural gas = 1 lb. coal
4,800 cu. ft. natural gas = 1 bbl. (300 lbs.) oil
4 1/6 bbls. oil = 1 ton (2,000 lbs.) coal

Feb. 1898 Preparations are being made to supply Chicago with natural gas from Indiana and residents of Indiana are considering an injunction to stop the enterprise from being consummated.

The foregoing chronology is not intended as a complete history of the natural gas industry in the United States in the 19th Century—far from it. It is a compilation of items taken at random from old files of the Journal, in the hope that they will be of interest to gas men in general and natural gas men in particular, as illustrating the early growth of what is now one of our most important industries.—J. F. H.



John Gilpin Rides Again

By ARTHUR K. AKERS

IN THE SHADE of the holders and by the blue waters of Chesapeake grizzled gas men tell it yet! Hotly blazed the sun on Baltimore that momentous morning of June sixteenth, 1916. Since dawn the whole city had been astir. For at last the great day had come, the vast parade celebrating the centenary of gas was about to move. Heat and tension filled the farthermost air and alley.

Hottest and tensest of all were the aides and marshals—men of gas and glory—for upon them devolved the success of the huge affair. And of them murmured the admiring thousands who lined the parade route, "They shall not fail!"

Weeks, months of preparation had gone into the event. The honor of the Consolidated Gas, Electric Light and Power Company was at stake—also in full charge of four marshals, each with four aides.

Yet what is a marshal without his horse, an aide without an equine? But such an unthinkable contingency, too, had been guarded against. Since mid-May company automobiles filled with set-faced men had been whirling mysteriously through the streets of Baltimore to Druid Hill Park. And if, coming back at dusk, at first they had ridden the return journey standing up on the running boards, *that* is another story!

At Druid Hill a lusty Teuton, one Hechter, the hostler, had met them, taken them in hand for horsemanship. And over Druid Hill now we draw a kindly veil. Among the aides and marshals were men to whom the quarter-deck of a horse was foreign territory. Suffice it that Hechter persevered. The aides and marshals perspired and persevered. Until at last the worthy Hechter had graduated them as horsemen; graduated them with misgivings, *magna cum laude,* and a magnum of liniment each.

And now the day had come! Not since the great fire of 1904 had there been such excitement throughout the city. Since dawn the populace fought for vantage points. Out in East Baltimore, on Broadway, near Johns Hopkins Hospital—significant site!—bands, floats, cars, marchers, blared and blistered beneath a searing sun. From afar, where wives, children, sweethearts, aunts, uncles and in-laws jammed the crowded curbs, was wafted sound of cheering. Vest buttons popped like musket-fire under the pressure of family pride.

And pride well placed it was! Magnificent in the morning light now were the aides and marshals. Picked men they were! Picked not so much for horsemanship as for the way they would look in black derby hats, blue coats, white riding breeches, and black leather leggings. Men of noble figure all; and foremost among them, on a riding Percheron, one Henry M. Riley, of whom more anon.

Now the parade is about to move. Four pulsating miles of it await the signal; twenty-five hundred men, fifty-two huge and gorgeous floats depicting the progress of gas, hundreds of cars, hundreds of horses—watch those horses!

Then through the simmering heat comes the *Boom!* of the City Hall bell; first of a hundred strokes to signalize the hundred years since Peale first charged admission to see that marvel of an earlier age, gas lamps burning in his museum.

Boom!—Boom!—Boom! clangored the distant bell. *Booomp!—Booomp!* hammered the hearts of the horsemen.

—Sixty-four—sixty-five—sixty-six —the bell clamors on. The spirit of the occasion enters even the horses. Aides dream dreams, and marshals see visions. Ten bands are already in line.

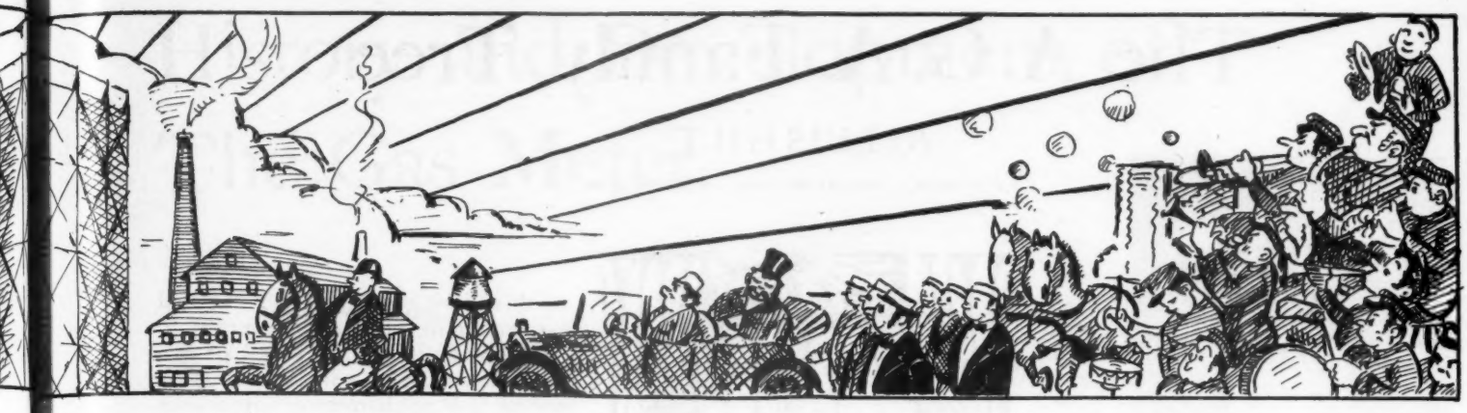
—Eighty-t h r e e—eighty-f o u r—eighty-five—booms the bell. Men and horses can stand no more; the populace cannot wait. Will *one hundred* never come?

But it comes! To be followed instantly by an even more stirring sound—the deep-throated boom of another bell: one cast especially for the occasion, to be borne sounding through the city streets ahead of the great procession for the next two hours.

"Here she comes!" screams an urchin, whose reason has been saved by the bell. "Here she comes!" swells the roar of the crowd. Westward the course of empire and the parade takes its way. *Clop-clop!* resound the hoofs of the horses. *Thump-thump!* go the hearts of the aides and marshals behind new highs in chest-wall expansion. Cheering sweeps like a tidal wave through the thoroughfares. Young girls swoon and old men weep enviously at the quality of the exhibits and the quantity of the horsemanship.

Hechter the hostler is doing handsprings alongside his charges and their chargers in sheer abandon. "Ach, Gott!" rings his pride in his handiwork, "Such an excellence of seat! And dot *Herr* Riley, how he rides! As though he were himself a senator!"

Onward, while not a hitch, not a bobble mars the magnificence of the spectacle. Like clock-work moves the parade. Scientific preparation is not only justified but glorified. Nothing is left to chance, still less is left



to the horse. And now, in plain view ahead on Mount Royal beyond Charles Street, lies its goal, the reviewing-stand. A stand filled with brave men and fair women; the mayor, the gas company officials, dignitaries and notables of every stripe and most hues! In brief, the climax of the whole Herculean effort will be in passage before that stand.

Onward *clops* the first division of the parade. A hundred years of gas are about to culminate as it marches before that stand in one final burst of scintillant glory. Consolidated Gas expects every man to do his duty! Hechter expects every horse to do his duty! On sweeps the parade. On sweeps H. M. Riley atop his Percheron. His blue coat's seams may have long since parted like the shell of a locust in August beneath the swelling emotions that had strained against its bosom; but like the rock of Gibralter still stands his pants! Back on the farm in Virginia, *Herr* Riley had ridden a horse, it was true; but never on such an occasion, never on such a horse as this. The blood sings in his ears. A century of gas looks down upon him!

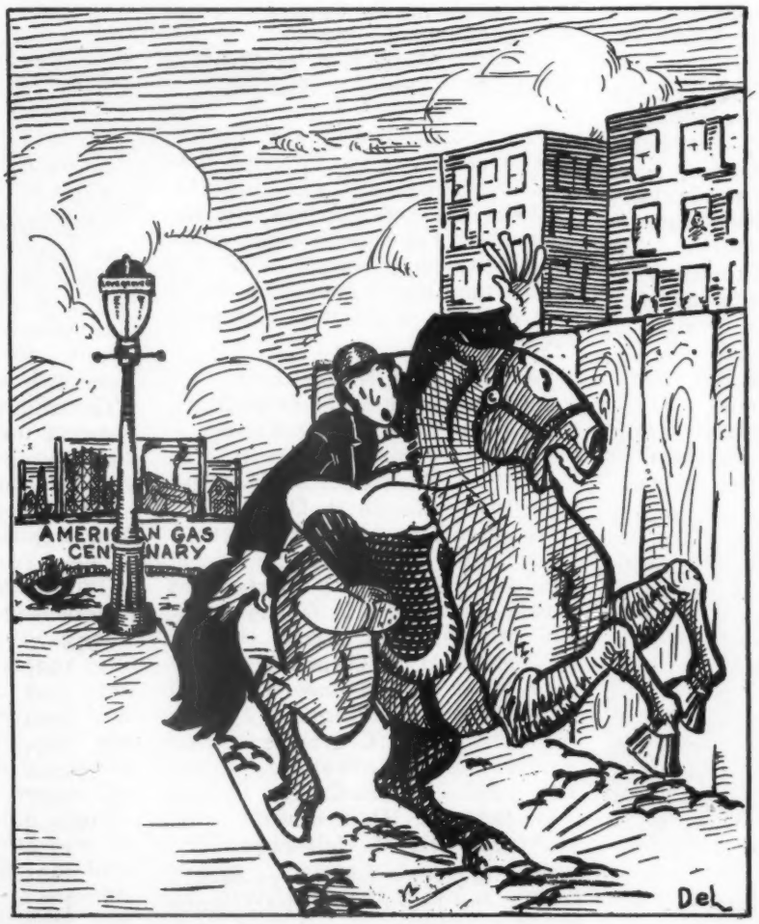
Bill Bray and Bart Wilson might have had trouble with their horses; another aide might have gone involuntarily and ingloriously off among the wharves at Light and Pratt, but not *Herr* Henry Riley!

A quiver runs along the line of march. A quiver runs along Riley's horse. For both—for Hechter—it is life's great moment. The drum major of Steinwald's Municipal Band just ahead lifts his baton sharply. All through the parade Steinwald's has been holding its full fire, awaiting this crucial moment when they shall blast the reviewing stand from its very roots with the fervor of their fanfare. But *now*—

The snare-drum rattles preliminarily. Breathing stops. Looking down from the stratosphere, Riley sees himself passing that reviewing-stand, in a moment more. All nature now is hushed. The very air quivers with suspense, waiting—

Then the baton falls. To the instant clash and crash of cymbal and drum, the band blares forth. *Fortissimos* that only Wagner only dreamed of rend the stricken air.

But, alas!, they rend, too, the mounts of the marshals and their aides! In sight of its goal, the first division literally explodes, casting off horsemen from it as a distintegrating planet might throw off moons. Five mounted aides and marshals go five frantic, different ways at once! Wild hoofs clatter on historic cobble-stones, striking off wild fire in their flight. Dozing grandsires leap to arms under the impression that again the British are coming. Childish cries of "Here *comes* Papa!" are instantly merged into "There *goes* Papa" as Papa passes, like some Paul Reverse on the day-shift.



"Wild hoofs clatter on historic cobble-stones"

But what of Riley?

And again we draw the veil—over Lovegrove Alley, leading off to the right; Lovegrove Alley a-clamor now with the footbeats of a Percheron; Lovegrove Alley a-shudder as *Herr* Riley traverses it like the wind, streaming volubly from the neck of his steed. . . . Riley, who, like the thirsty camels of Sir Launfal, is destined never to reach the oasis of that stand!

(*Continued on page 144*)

The A. G. A. Family Tree

By LUIS HILT
Librarian, American Gas Association

THE American Gas Light Association was the first national gas association to be formed in this country, and it was created as the result of an informal preliminary meeting held in Cleveland, Ohio, in September 1872. The first meeting of the Association, which was originally called the Gas-Light Association of the United States and later in 1874, the American Gas Light Association, was held at Masonic Hall in the City of New York, October 15th, 1873. A list of its Presidents follows:

1873–79	Charles Roome
1880–81	William H. Price
1882	Andrew Hickenlooper
1883	Theobald Forstall
1884	William A. Stedman
1885	Eugene Vanderpool
1886	Austin C. Wood
1887	Malcolm S. Greenough
1888	Thomas Turner
1889	Alpheus B. Slater
1890	Emerson McMillin
1891	John B. Harbison
1892	William Henry White
1893	Arthur E. Boardman
1894	William H. Pearson
1895	Walton Clark
1896	C. J. R. Humphreys
1897	Chas. H. Nettleton
1898	J. B. Crockett
1899	Alex. C. Humphreys
1900	Geo. G. Ramsdell
1901	Edward G. Pratt
1902	Wm. R. Beal
1903	Alten S. Miller
1904	Rollin Morris
1905	E. G. Cowdery
1906	Charles F. Prichard

The American Gas Light Association as such held its last meeting in October 1905 and in Chicago, on the 17th, 18th, and 19th of October 1906, the first annual meeting of the American Gas Institute was held. The new Association was the result of long discussed plans for its formulation, which were finally consummated on July 10th, 1906, when a special committee passed the resolution merging the American Gas Light Association, the Ohio Gas Association and the Western Gas Association. A list of the men who served as Presidents follows:

1906	B. W. Perkins
1907	Walton Clark
1908	A. C. Humphreys

1909	C. F. Prichard
1910	W. H. Bradley
1911	Donald McDonald
1912	I. C. Copley
1913	W. R. Addicks
1914	W. H. Gartley
1915	E. C. Jones
1916	William E. McKay
1917–18	Alfred E. Forstall

The first meeting of the Natural Gas Association of America was held in Kansas City, Mo., June 12-13, 1906. Its consolidation with the American Gas Association was consummated on Aug. 1, 1927. Up to this time the Natural Gas Ass'n of America had the following Presidents:

1906-07	Kerr M. Mitchell
1908-09	Jesse C. McDowell
1910	Wm. H. McKenzie
1911	John M. Garard
1912	Alexander B. MacBeth
1913	Martin B. Daly
1914	Ernest L. Brundrett
1915	James T. Lynn
1916	William Y. Cartwright
1917-18	Joseph F. Guffey
1919	Kay C. Krick
1920	B. C. Oliphant
1921	H. J. Hoover
1922	L. B. Denning
1923	J. D. Creveling
1924	H. A. Wallace
1925	Jno. B. Corrin
1926	A. W. Leonard
1927	R. W. Gallagher

It is necessary here to go back a little to the 12th of May 1905, when the National Commercial Gas Association was officially formed. Prior to this time there was no national association devoting all its energies to the commercial or sales end of the gas business, nor were manufacturers of gas appliances or apparatus very much in evidence in association work. Therefore, with its object to extend the sale of gas and gas appliances and to promote fuller and more complete cooperation between gas companies and the merchants who handled gas burning equipment, the National Commercial Gas Association was organized. The first annual meeting was held in January 1906, and the first exhibition of gas appliances and accessories was held in December 1907, coincident with the convention in New York City. A list of the Presidents follows:

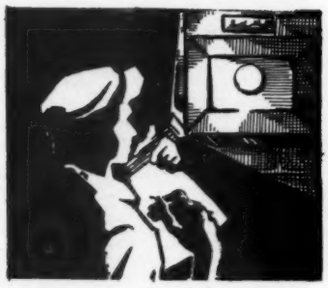
1905–7	William J. Clark
1908	Frank W. Frueauff
1909	J. D. Shattuck
1910	E. N. Wrightington
1911	Clare N. Stannard
1912	Charles L. Holman
1913	C. Willing Hare
1914	Percy S. Young
1915	H. B. McLean
1916	Jansen Haines
1917–18	James T. Lynn

The American Gas Association was formed after the Executive Boards of the American Gas Institute and the National Commercial Gas Association had voted to amalgamate, for which purpose a joint committee was appointed to prepare a Constitution and By-Laws, and at a special meeting in New York City on June 6th and 7th, 1918, the present Association was organized.

The first annual convention of the American Gas Association was held in New York City on October 13th to 18th, 1919. A list of the A. G. A. Presidents to date follows:

1918–20	George B. Cortelyou
1921	Charles A. Munroe
1922	Dana D. Barnum
1923	R. B. Brown
1924	J. B. Klumpp
1925–6	H. C. Abell
1927	A. B. Macbeth
1928–9	Oscar H. Fogg
1930	B. J. Mullaney
1931	Clifford E. Paige
1932	R. W. Gallagher
1933	Arthur Hewitt
1934	H. O. Caster

History and Development of The Gas Meter



By GEORGE WEHRLE,
Superintendent, Gas Department
Public Service Company of Colorado,
Denver, Colorado

Introduction

AT THE outset of the gas industry, the need for a device for measuring gas volumes used by consumers was recognized. Before the development of such a device, gas was sold to the public by contract on a "flat-rate" basis in which charges were based upon the number of burners employed and upon the supposition that these burners consumed a given volume of gas in a given period of time obviously this method of charging for gas was unsatisfactory, resulting in fraud and waste, and the early gas engineers bent their efforts toward the perfection of a practical measuring device, or meter.

First Iron-Case Meter (1888) Metric Metal Works, Type C

Eleven years before Murdoch, in 1792, demonstrated the first use of gas manufactured from coal in lighting his residence in Redruth, Cornwall, a French chemist, Lavoisier, had invented the gasometer which later was developed into the gas holder. The first use to which the inventor put this device was in the measurement of gases for experimental purposes and to this man is due the credit of designing the first gas meter of any sort. It was not until 1815, after illuminating gas had been in use for more than twenty years, that Samuel Clegg constructed a gas meter, but he is usually accredited with being the earliest inventor of an instrument for measuring gas. Clegg's first meter was not a practical success and in 1817 John Malam invented an improved type which resulted in the construction of meters universally employed in the early days of the gas industry.

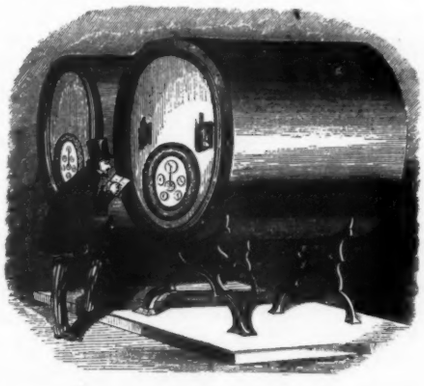
In the meantime, Sir William Congreve experimented with a device which he called an "hour meter." It consisted of a timepiece attached to a valve on the service pipe which was started when the valve was turned on and stopped when the valve was turned off. As in the "flat-rate" method of charging, the flow of gas was supposed to be proportional to the time the gas was used so that this type of meter, in recording the time gas was actually burned, simply removed one of the assumptions used in the "flat-rate" method but showed no other improvement.

The first meters designed by Clegg and Malam were of the so-called "wet" type consisting of a cylindrical shell enclosing a measuring wheel, or drum, which was divided into a number of compartments and immersed in water to a given height. The drum was revolved on a horizontal axle by the pressure of the gas flowing. In 1820, Malam invented a "dry" type meter, which was not a success, and in 1833 and again in 1836, Bogardus met with like failure in his attempts. In 1884, Messrs. Richards and Croll patented the "dry" gas meter which, so far as basic principle is concerned, is unchanged in the meter universally used today for the measurement of gas to consumers. Thomas Glover made subsequent improvements upon Richards' and Croll's meter and the two-diaphragm, slide-valve tin meter, with which all gas men are familiar, is known as the Glover type. While the principle of the "wet" type meter, as developed by Clegg and Malam, is still quite generally used in station and test measuring, its use in consumers' meters has been entirely superseded by the Glover principle.

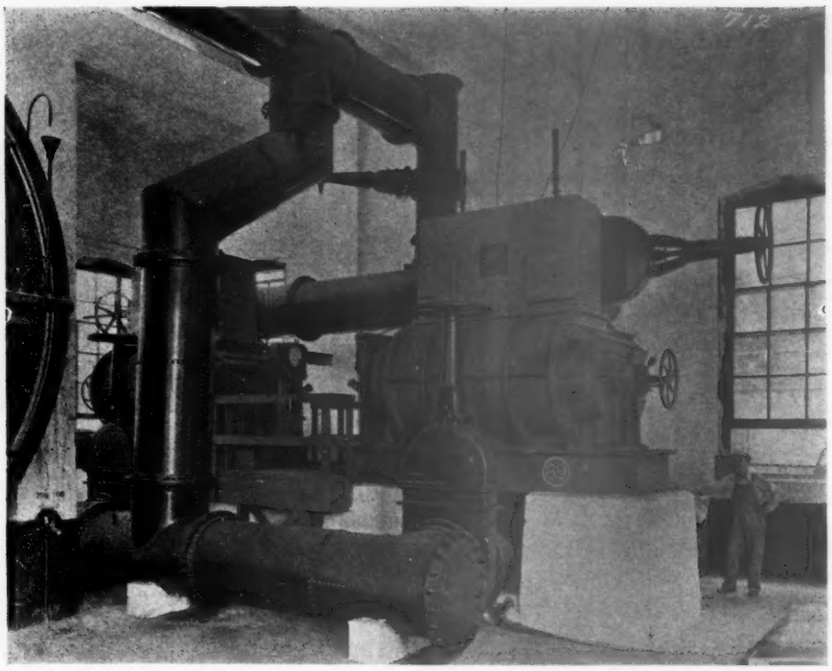
Consumers' Meters

There was very little development in gas meters in the generation following Glover's work and it was not until late in the nineteenth century that the need for drastic improvement, particularly in meter capacities, became apparent. The original rated capacity of consumers' meters of various sizes was based upon the "light" standard which designated the number of standard flat-flame illuminating burners each consuming six cubic feet of gas per hour that the meter would supply with a given pressure loss. By this standard, a so-called "five-light" meter had a rated capacity of 30 cubic feet of gas per hour.

By the year 1904, when plans for



Philadelphia Meter Room of Seventy-five Years Ago



1000 M. C. F. per Hr. Connersville Station Meter Installation

materially correcting deficiencies in consumers' meters were completed, rated capacities had been increased until the "five-light" size would supply 95 cubic feet of gas per hour with one-half-inch pressure loss. The plan as approved by prominent gas engineers and meter manufacturers of the time, while stressing the need for increased capacities, recognized the need for other important considerations which were as follows:

1. Less repairs
2. Longer life or service
3. More accurate registration
4. No increase in investment cost.

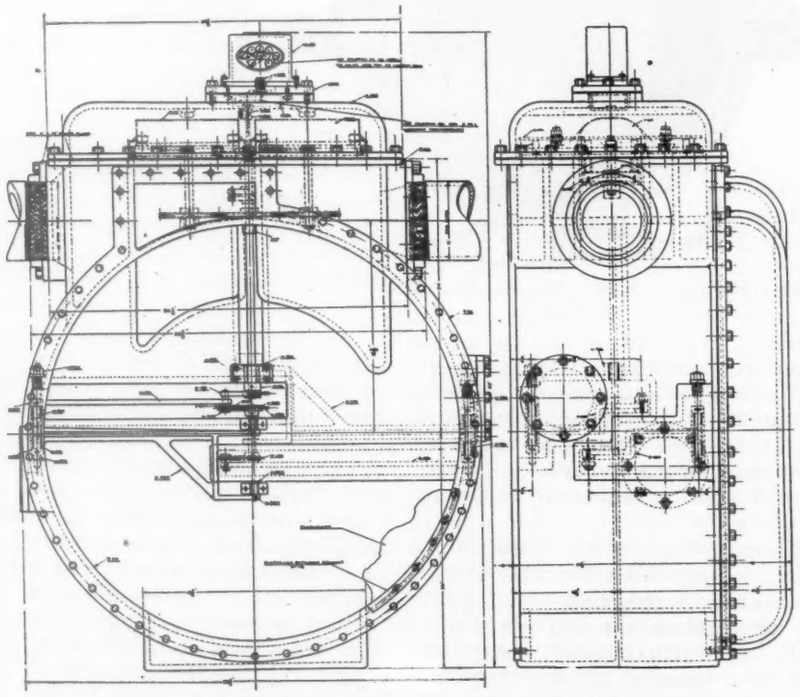
A new-style tin meter was developed from this study which met the demands of the gas industry. This meter, by the same number of tangent revolutions per cubic foot, increased the rated capacity of the "five-light" size from 95 cubic feet to 156 cubic feet per hour with one-half-inch pressure loss. It was rugged in construction and was capable of handling overloads fifty per cent greater than rated capacity, thus providing for peak-hour requirements. Three decades have gone by since the development of this so-called "high-capacity" tin meter. It has stood the test of time and, with little change from the original 1904 model, stands today as an eminently satisfactory type of measuring equipment.

Although the Glover principle remains the same, progress has been made in "dry" meter design and particularly in the materials used in its construction. The use of cast iron or pressed steel for meter cases was suggested by the increasing cost of tin plate and solder, the greater strength and ability to withstand rough treatment and action of the elements, and by the accessibility for repairing. Manufacture of meters of this design was begun in 1900 and today, for domestic meters and for larger sizes where rated capacities of units extend as high as 30,000 cubic feet per hour, the field is well covered with a satisfactory product.

Station Meters

For many years, the Clegg-type meter was in general use for measuring gas in manufacturing plants. Various improvements were made by Crosley and Parkinson and later by Hinman, particularly in the design of the revolving drum, but the "wet" station meter of today is but slightly changed from the meters of Clegg and Malam in 1815-17.

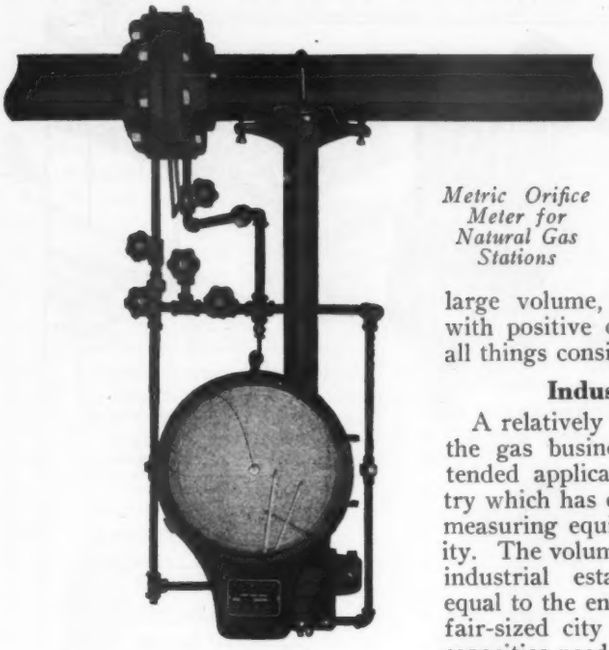
As the use of gas was extended into the fuel field, the volumes of gas manufactured were greatly increased and the need for a station meter, which would occupy less space and have a lower investment cost per unit of volume of capacity, became apparent. An early type to appear was the so-called "Rotary" meter which used the principle of velocity to rotate an anemometer which in turn actuated the registering mechanism. Pitot tube, venturi and orifice meters using the velocity, or flow, principle, and proportional meters of various types were used with a varying degree of satisfaction for measuring manufactured gas and two widely different types of station meter, known as the Thomas electric-gas and the Connersville and Roots positive displacement meters, came into general use in recent years.



The Largest Size Glover Type Meter—Sprague—3200 C. F. per Hr.

The Thomas meter applies the

unique principle of raising the temperature of the flowing gas a given amount by heating with electric current. The amount of current required is measured by an ordinary watt-hour meter and the flow of gas heated is proportional to the current consumption, so that the integrator registers in cubic feet of gas. This meter is remarkably accurate and extensively used.



Metric Orifice Meter for Natural Gas Stations

Meters of the Connersville type are a development of an endeavor to integrate the revolutions of the impellers of an ordinary exhauster into cubic feet of displacement. The result has been a meter which occupies a minimum of space per unit of capacity, has low investment and operating costs and a high degree of accuracy.

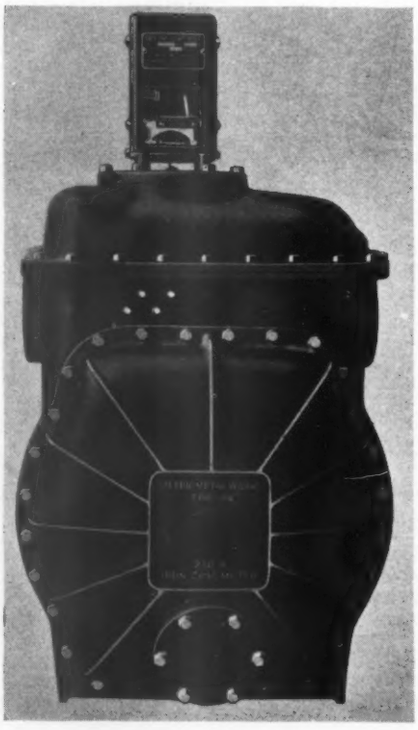
In the category of station meters belongs the orifice meter now universally used for measuring natural gas delivered to gas distributing companies and to large industrial establishments. The invention of an orifice meter of practical design is credited to John G. Pew, and H. C. Cooper who in 1911 produced and installed a meter of this type in West Virginia to measure natural gas. These experimenters found that the formula for the principle of the pitot tube, wherein the velocity of a flowing fluid as indicated by the difference between the static and dynamic pressures, corresponds to the volume of fluid flowing, would apply for an orifice which permitted an instrument to be developed having wide application and great flexibility as a gas measuring device.

Meters of the orifice type are used today in the town border measuring stations of numerous gas utilities that have changed from manufactured to natural gas in the present decade, and this principle used widely in the natural gas business for many years has become well known in the entire gas industry, where it is now recognized as an accurate principle in measuring gas, particularly of large volume, comparing favorably with positive displacement methods, all things considered.

Industrial Meters

A relatively recent development of the gas business has been the extended application of gas in industry which has created a need for gas measuring equipment of high capacity. The volume of gas used in many industrial establishments today is equal to the entire requirements of a fair-sized city so that the range of capacities needed in industrial metering installations may extend from the category of consumers' meters to that of station meters.

As in any branch of engineering, gas measuring requirements can be scientifically and economically determined. It has been found in the natural gas business that an economical breaking point exists dividing the use of displacement and orifice meters. Individual analysis of investment and operating costs, when properly considered, will determine that up to a certain demand a battery installation of large-sized consumers' meters may be most economical, after which economy favors some other type of equipment.



Modern Type High Pressure Iron-Case Meter with Base Pressure Index

Modern Type American Domestic Tin Plate Meter with Straight Reading Index

We have followed the development of the gas meter in its march of progress from Lavoisier's gasometer to the present day. It is found that this period of a century and one half may well be divided into epochs corresponding to outstanding achievement affecting progress. The first, extending from Lavoisier's to Clegg's and Malam's inventions of 1815-17, probably represents a period of unrequited endeavor. The second, extending to the time of Richards' and Croll's invention, actually saw a satisfactory measuring device in general use for the first time. The third, ending with the early days of the twentieth century when drastic improvements in consumers' meters resulted in the development of the so-called "high-capacity" meter, may be said to represent the most inactive period in the history of the gas meter. The fourth, in which we now find ourselves and in which has been brought out some of the most notable accomplishments, is an open page.

Whereas the gas engineer of early days sought for a practical device to measure gas, no matter how crudely, we of the present day demand an instrument which will measure gas with great accuracy and which will maintain this accuracy for a period of years consistent with a reasonable

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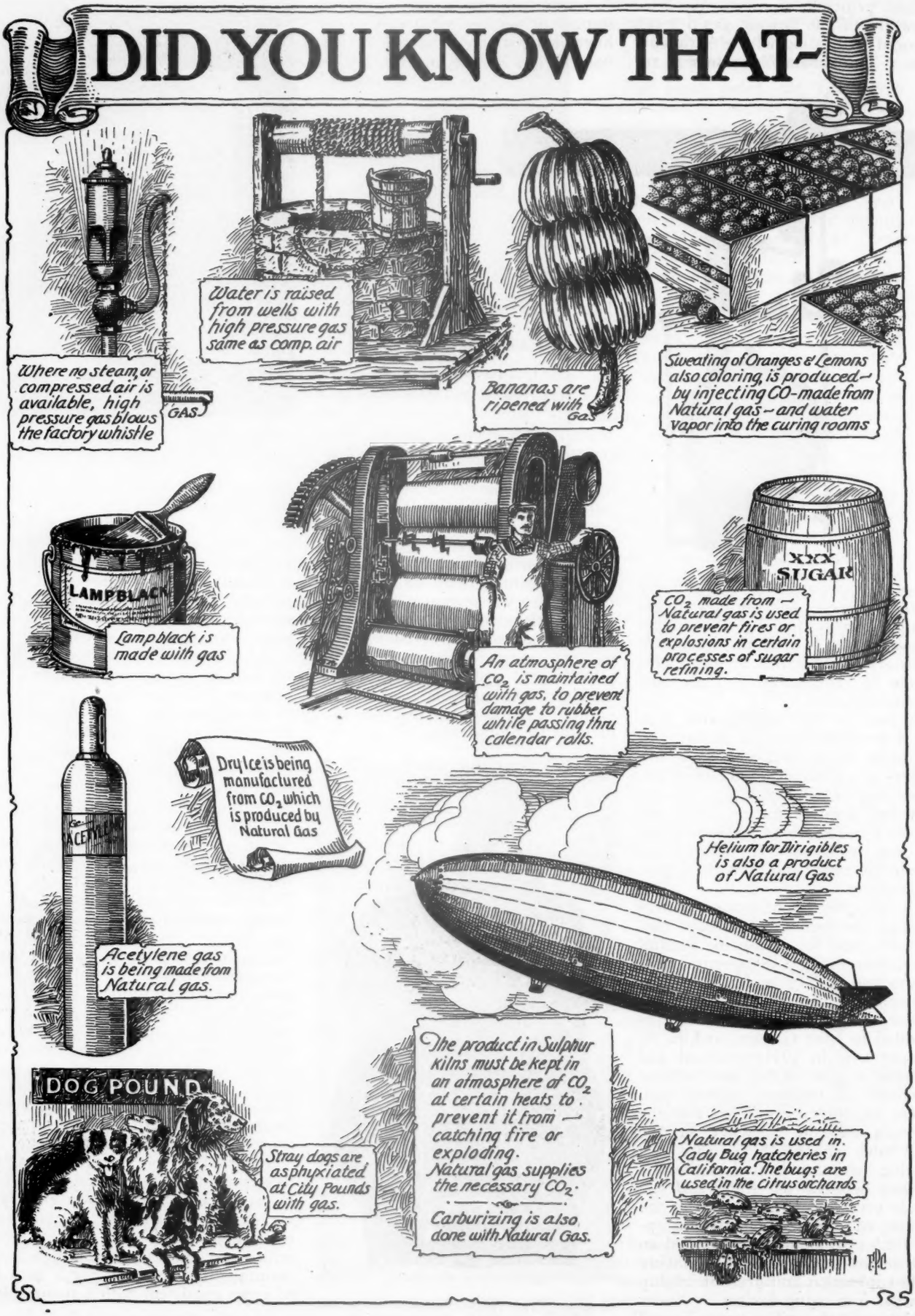

DID YOU KNOW THAT-
Where no steam or compressed air is available, high pressure gas blows the factory whistle
GAS
Water is raised from wells with high pressure gas same as comp. air
Bananas are ripened with Gas
Sweating of Oranges & Lemons also coloring, is produced — by injecting CO-made from Natural gas — and water vapor into the curing rooms
LAMPBLACK
Lamp black is made with gas
An atmosphere of CO_2 is maintained with gas, to prevent damage to rubber while passing thru calendar rolls.
XXX SUGAR
CO_2 made from — Natural gas is used to prevent fires or explosions in certain processes of sugar refining.
Dry Ice is being manufactured from CO_2 which is produced by Natural Gas
ACETYLENE
Acetylene gas is being made from Natural gas.
Helium for Dirigibles is also a product of Natural Gas
DOG POUND
Stray dogs are asphyxiated at City Pounds with gas.
The product in Sulphur Kilns must be kept in an atmosphere of CO_2 at certain heats to prevent it from — catching fire or exploding. Natural gas supplies the necessary CO_2.
Carburizing is also done with Natural Gas.
Natural gas is used in Lady Bug hatcheries in California. The bugs are used in the Citrus orchards
EPC

Some Coal Gas Notes

By R. H. BURDICK

Columbia Engineering Corporation

AMONG the remarkable developments in the gas industry which the *American Gas Journal* has witnessed during its seventy-five years of active life are those pertaining to the production and distribution of the oldest of manufactured "illuminating" gases—coal gas. This was the only commercially made gas distributed for general use when the *Journal* first emerged from its chrysalis of galley proofs and moist printers' ink on July 1st, 1859.

A review of the progress made in coal gas generating apparatus, from William Murdock's iron retort of 1792 to the present day efficient vertical bench and modern coke oven, indicates that the brain power of diverse branches of science and industry were enlisted in the evolution of machinery and equipment required to produce this oldest and best known of the family of "city gases."

Iron founders, mechanical and electrical engineers, physicists, chemists and coal and refractory miners have vied with just plain gas men in making constructive contributions to this march of progress.

Consider the changes which have taken place in retort materials, shapes and placements. Murdock's vertical iron affair gave way to hand-operated horizontal iron retorts, one to a bench, and that heated to only a relative moderate temperature by direct firing, wherein coal, coke, wood, tar or in fact any convenient combustible material was used as fuel.

About 1820 retorts of fire clay began to make their appearance, although this material did not come into general use until the year 1859.

One by one more retorts were added to benches to conserve carbonizing fuel, an economic factor forwarded very materially by the gradual replacement of direct firing methods by the recuperative system of heating with producer gas.

A maximum of sixteen horizontal retorts per bench was tested out on a large scale some years ago in a New England plant without, however, meeting with any practical success.

As in the case of practically all industrial operations, labor saving machinery was evolved to carry on some of the more strenuous work of charging and discharging retorts, which in turn permitted of their being lengthened with a corresponding increase in carbonizing capacity per bench.

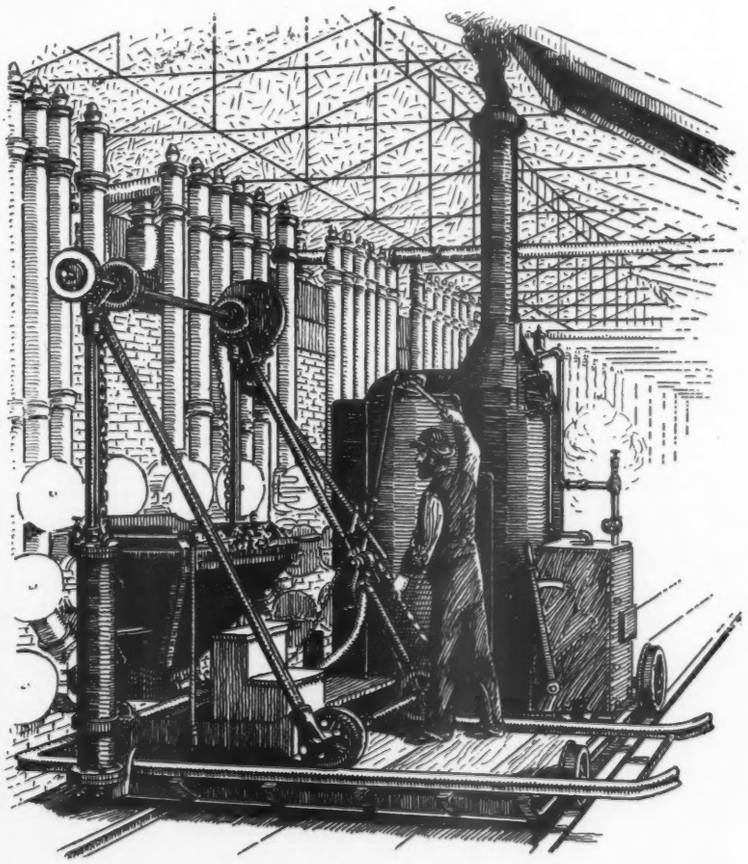
In order to offset further rises in labor costs, retorts were more recently placed in inclined settings to secure the aid of the strong arm of gravity in charging and discharging operations. This concept merely proved to be an intermediate step toward the complete up-ending of retorts as exemplified in the modern version of the vertical bench which by curious coincidence was a reversion in principle to Murdock's original arrangement.

Intermittent Vertical Retorts

According to historical record, intermittently operated vertical retorts were the subject of certain patents applied for about 110 years ago, although benches incorporating this principle were not built commercially until about 1900.

In form and dimensions the retort has undergone many changes. For horizontal benches the present accepted cross section is shaped like a modified "D" which conforms to the modern ideas of requirements for maximum carbonizing surface, gas passage, coal fluxing and expansion and strength and convenience of setting. Earlier cross sectional forms embodied numerous variations of the oval, square, circle and hexagon. The oval cross section form (and longitudinal taper) is to be found in certain types of recently constructed vertical benches and the "slot" or chamber oven is quite reminiscent of the old square retort.

The composition of retort and setting materials has been improved from the early plastic clay—which was a none-too-good conductor of heat and difficult to keep free from demoralizing cracks even at moderate temperatures—through a series of stronger and better selected refractory clays to the now much used siliceous clays to the new much used tively high heats and rapid heat transfer. The once integral moulded clay retort has been completely



Ross Charging and Drawing Machine, 1880.

The Retort Room in The Philadelphia Gas Works in the late Fifties.

abandoned in favor of the segmental "silica-clay" block type. During certain stages of retort material development, fused silica and carborundum were tested in actual service but did not fulfill all of the requirements imposed on them. Their chief merit lay in the rapidity with which they could conduct heat into the coal mass to be carbonized but they were found to be lacking in mechanical strength.

Direct heating of retorts from a furnace built directly beneath them, proved uneconomical and inefficient and a distinct limiting factor in bench design which restricted the number of retorts per setting as well as the length of carbonizing periods.

Experiments with producer gas about 1893 as a bench heating medium proved so successful that the producer has become an integral part of every carbonizing plant.

It has become common practice to build a producer into each bench so arranged that hot coke may be fired directly into it from the bench retorts without any material heat loss. Standard gas producers installed and operated at some distance from the benches utilizing their gas are to be found in some of the larger coal gas plants.

The employment of recuperators for preheating secondary air, the careful placement of bench nostrils and tile control dampers, revisions of flue designs and the use of carbon monoxide economizers, have all contributed to improved bench efficiencies. A more recent innovation is the use of the regenerative system of bench firing, vertical benches of some designs having copied a page in respect to efficient firing from its mass carbonization companion — the coke oven.

In a few coal gas bench installations, waste heat boilers have added a final touch in reclaiming the maximum number of thermal units from the fuel used for carbonizing purposes.

Among the series of intricate problems caused by increased bench heats and modifications in design and materials used in bench construction, is that of arranging for a proper supporting structure of iron and steel,—a frame work strong enough to hold the brick and refractory assembly in rigid form and yet flexible enough to compensate for variations in expansion and contraction caused by heat fluctuations within and without a stack of benches. Today, after a long period of experimentation, this phase of bench construction has been brought to a high state of perfection.

Coal and coke handling equipment and apparatus has probably undergone more fanciful changes in design than any other element closely associated with coal gas making. The old "gas house terrier" with his barrow, shovel and rake represented the maximum of simplicity in retort charging and discharging machines. Next came the full-charge scoop, loaded with coal at convenient times but generally in inconvenient places, which was boosted into a retort by brute force but with considerable skill and dexterity A little later came the make-shift block and tackle rig to aid in the scoop boosting action

Then the Bronder steam actuated charger and rake,—what a machine! Many of you older gas men remember that contraption which resembled nothing so much as a fire engine with the temperament of a nervous bull and which served bench builders well by frequently knocking the backs and sides of retorts into bits.

When retorts were finally opened at both ends and the "through" type of bench became an accepted design, the pusher type of discharging apparatus came into being and along with it the motor operated split scoop charger together with their attendant intricate overhead coal bins, hoppers, coal valves (both automatic and stubborn) conveyors, trippers and skips.

Inclined and vertical benches eliminated a lot of these elephantine gadgets. Simplified coal conveying

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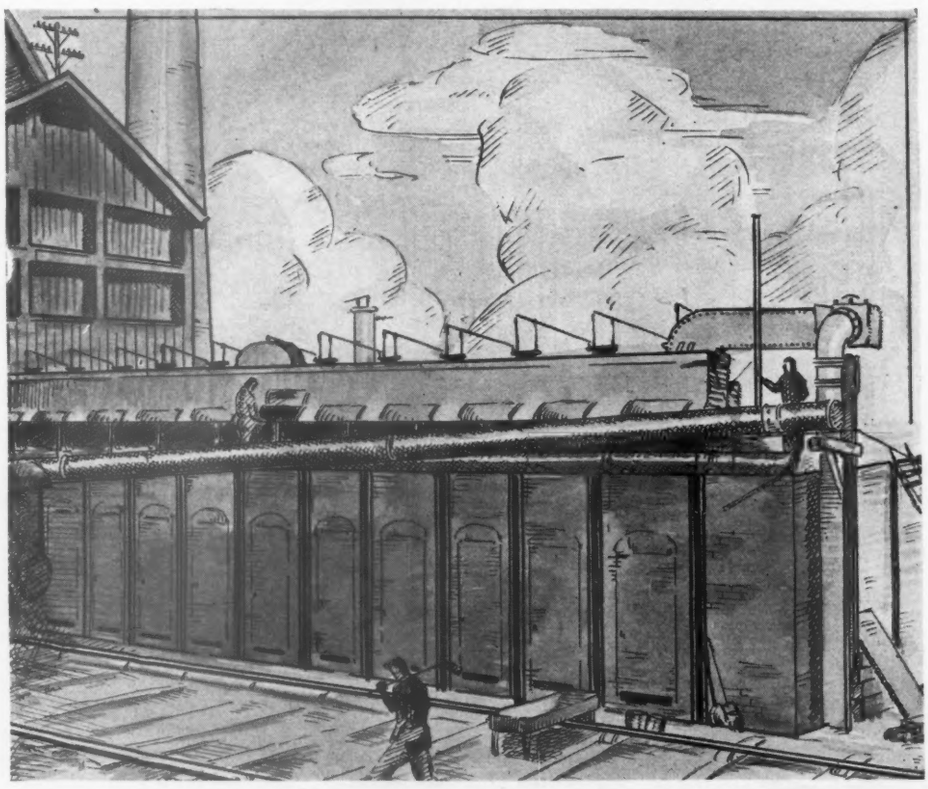


First By-Product Coke Oven Plant, erected in Syracuse by Semet-Solvay in 1892. Gas Companies now buy over 90 Billion Cubic Feet of By-Product Coke Oven Gas Annually.

Three Quarters of A Century of American Water Gas Progress

Water Gas Works at Norristown, Pa., Erected in 1875. Building on right i the Windsor House in which Cooking was done with Gas.

By JOHN H. WOLFE

Supt. Gas Manufacturing
Cons. Gas Electric Light & Power Co., Baltimore

IF THE PIONEERS of the water gas industry were privileged to witness the operation of a modern water gas plant, they would be struck by the flexibility, adaptability and capacity of the equipment and by the cumulative effect of the ingenuity exercised to produce apparatus which is so economical in the use of both labor and raw materials. It is apparently a far cry from the earliest practice in water gas manufacture with its natural draft generators and separately fired carburetters or "illuminators" to the self-contained, highly mechanized, modern water gas set. An examination of the historical background will, however, show that this development was both logical and inevitable. A resumé of this history will inspire an admiration for the persistence and perseverance of the engineers and inventors, a long list of which have contributed to the successful development of a great industry.

The history of water gas may be roughly divided into four periods as follows:

1780 to 1852. Origin of Water Gas and Foreign Experimentation and Invention.

1852 to 1872. Preliminary American Invention and Application.

1872 to 1900. Development and Standardization of Lowe Apparatus.

1900 to 1934. Perfection of Auxiliaries, Improvements in Economy of Operation and Mechanization of Water Gas Apparatus.

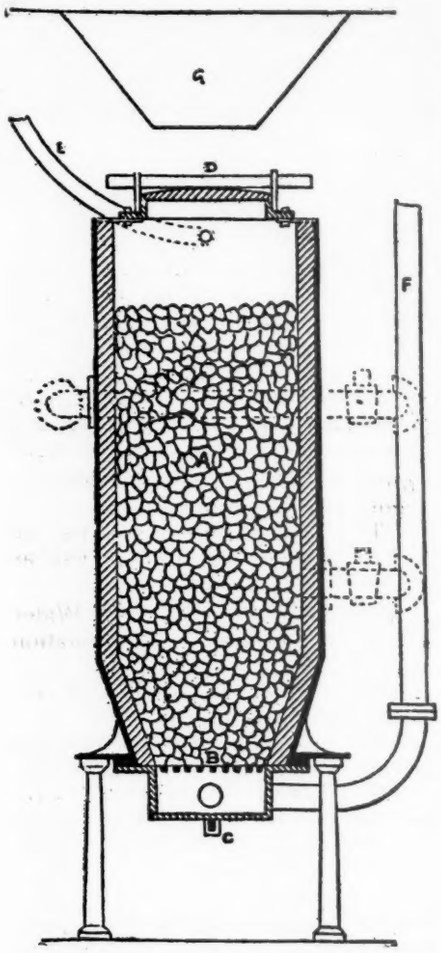
Professor Lowe discusses his process with a gas executive.

First Period—1780 to 1852 Origin of Water Gas and Foreign Experimentation and Invention

Cavendish's discovery of the composition of water, which plays such an important part in the manufacture of water gas, was announced in 1784. Although ignorant of the chemical constitution of water Fontana had, four years earlier (1780), proposed to manufacture a gas by passing water over ignited iron and coal. This work was followed by that of Lavoisier and Meunier, who first made hydrogen by passing steam through a red hot iron pipe and later, because of their knowledge of the affinity which carbon had for oxygen, passed steam through a red hot pipe filled with charcoal to make water gas.

French patents were taken out in 1817 and 1819 by the Gengembres, father and son, for the manufacture of gas by the action of steam upon

charcoal, which gas was mixed with coal gas produced in the same retort. Later (1823), Vere and Crane patented a process for producing gas by introducing water or steam into retorts in which coal or oil was being distilled.



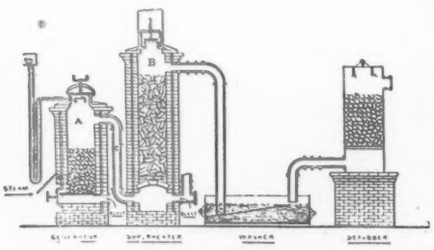
George Lowe Generator, 1831.

Great interest was shown in the water gas process from the time Ibbetson took out his patent in 1824 for admitting "steam into the decomposing chamber, when in operation, among the ignited coal or coak, alone or mixed with tar or oil." In fact, a total of sixty patents was listed in the September 16, 1864, issue of the *American Gas Light Journal,* the illustrious predecessor of this *Journal.* Few of these inventions progressed further than the granting of patents. Several were actually tried out on a plant scale, the most important being those of Michel Donovan 1830, George Lowe 1831, Jobard-Selligue 1834-36, Val Marino 1839, Stephen White 1847-49, Le Prince 1848 and J. P. Gillard 1849.

To Michel Donovan belongs the distinction of being the first to actually make and distribute water gas. The gas, which was made by passing steam over red hot coke or charcoal and carburetted by volatile hydrocarbons, was used in 1830 for public lighting in Dublin, Ireland. This gas was actually a carburetted water gas.

George Lowe, engineer of the Chartered Gas Company, London, was the inventor of the first internally fired generator. The air for combustion was furnished by natural draft by opening the top and bottom generator doors, which were later closed when steam was admitted at the top. The resultant gas was then carburetted.

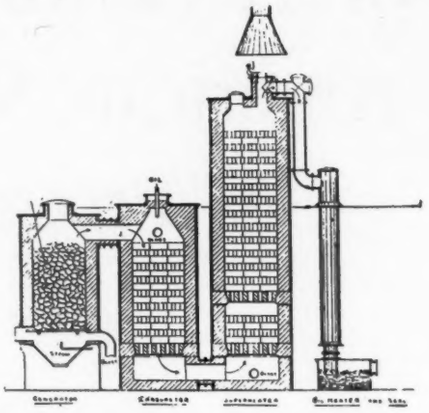
The Jobard-Selligue system employed semi-cylindrical retorts, arranged vertically in pairs and heated externally from above and below by grates at two levels. Each retort was divided vertically by a firebrick partition and the water which was admitted at the top of one side passed —first downwards, then upwards, and finally to a third cylinder heated red hot into which shale oil was admitted. Apparatus was installed in 1836-38 in Dijon, Antwerp, Strassburg and Paris and appears to have been successful in operation.



Original Form Lowe Water Gas Apparatus: 1873

Val Marino's apparatus, patented in 1839, consisted of three vertical, externally heated retorts, all filled with coke or other combustible. Water, admitted at the top of the first retort, was decomposed in passing down and enriched in passing up through the second retort by oil or fatty matter. The third retort fixed these enriching vapors in the gas. Cruckshanks, in the same year, recommended superheating the steam and the producing of illumination by utilizing the incandescence of a platinum ball or wire cage.

An English development of 1847 was that of Stephen White, who introduced his system in the towns of Ruthin, Southport, Warminster and Dunkeld, in many mills and factories in Lancashire and in the South Metropolitan Gas Works, London. This apparatus consisted of two horizontal retorts, into which melted resin and oil were syphoned and decomposed, and two vertical retorts, filled with iron scrap and charcoal, into the top of which water was introduced. The resulting water gas was used to sweep out the oil and resin gas from the horizontal retorts.



Modern Form Lowe Water Gas Apparatus: 1889

The Le Prince system employed a single retort, which was divided into three unequal chambers. The material to be distilled was placed in the largest, the coke for decomposing the water in the second, while the gases formed in the first two chambers mixed in the third in the presence of coal. Plants were installed in 1848 in Mastricht, in some of the departments of the Vielle Montagne at Verviers and in several industrial concerns at Liege.

A patent was granted to J. P. Gillard in 1849 for the manufacture of hydrogen (water gas) from steam and heated carbon in a retort. The gas was used for illumination by burning it under a platinum basket or cage. For several years this system lighted the streets of Narbonne and Passy and foreshadowed the incandescent gas light of Welsbach.

Second Period—1852 to 1872 Preliminary American Invention and Application

The first record of the practical application of water gas apparatus in the production of manufactured gas in America was that of John and Thomas Kirkman, patented in 1852 and 1854, and installed in the Municipal Gas Light Company's works in New York City. The apparatus was composed of twin generators and air preheaters and a common, brick filled mixing chamber. Air, under natural draft, entered the bottom of a preheater, passed up through it, being preheated by the products of combustion, then to the side or bottom of the generator and up through the fuel bed, the products of combustion going to the top of the air heater, down through it and to the

stack. During the run the steam was admitted at the top of the generator, was decomposed by passing down through the fuel bed and passed into the mixing chamber, where it met and was mixed with a "gas rich in carbon."

Processes which used horizontal, vertical or L shaped cast iron retorts set in benches in accordance with coal gas practice, or which used the usual horizontal cast iron, coal gas retorts for producing the water gas, followed Kirkman's apparatus in rapid succession. Among these were the Sanders apparatus (1858), the Gwynne-Allen-Harris equipment (1858-1875), the Ruck (1873), the Spice (1873), the Beatley and Gill (1875-1876) and the "Acme."

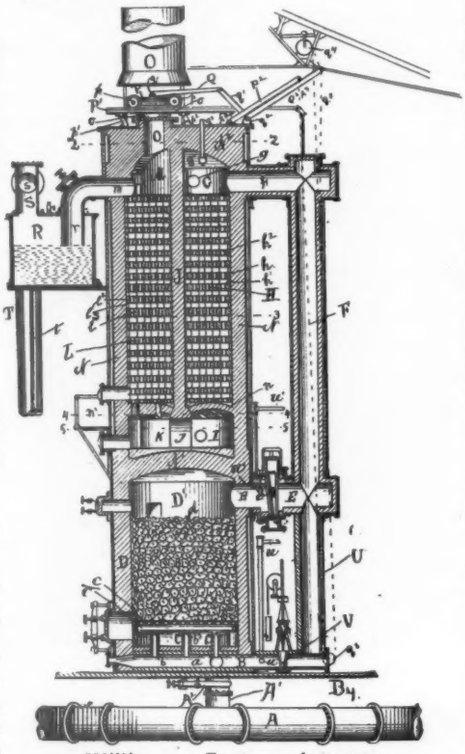
One of these systems, the Slade, was operated for a considerable time, in fact, during the early development period of the Lowe apparatus (1883 to 1889), at the works of the Yonkers Gas Light Company, Yonkers, New York, by the inventor, who was superintendent of the plant. Steam and naphtha were introduced into ordinary coal gas retorts charged with coke. It is thought to be the last of the externally fired retort processes for making water gas.

Third Period—1872 to 1900 Development and Standardization of Lowe Apparatus

We have seen how the inventors of the preceding period were influenced by coal gas retort practice and experience in developing their ideas. Their solution to the problem of making water gas, was, with the exception of the Kirkman's, two externally heated retorts, one for generating the blue gas and another for vaporizing and fixing the resin, oil or naphtha gases for carburetting.

We now enter into a period of tremendous activity in which the inventors were inspired by a desire to make gases of a candlepower much higher than was possible in either coal gas or current water gas practice. The infant electric industry was beginning to offer competition which threatened the only large market which the gas industry then had, the lighting load. Higher candlepower of the gas, with reduced cost to the consumer, was the gas industry's immediate answer to this threat and this answer was made possible only by the activities of Prof. Thaddeus S. C. Lowe and his contemporaries. These men perfected a system which utilized an internally fired generator and internally fired vaporizing and fixing chambers which were heated by the combustion of, and sensible heat in, the generator gases.

The initial victory in the lighting field had just been won when the gas industry's hand was further strengthened by the invention of the Welsbach incandescent light. Although this device demonstrated in a very short time that the heating value and not the illuminating value of this gas was the important and prime consideration, the water gas process had become firmly established and succeeded in demonstrating its flexibility in operating under the new conditions which had been imposed, namely—that of producing gas for heating instead of for illuminating purposes.



Williamson-Eustace Apparatus

The first combination generator-retort system to be tried was the Harkness (1874). Natural draft was used in the generator, which was small and difficult to fire and maintain in proper condition. To correct for the small volume and irregular blue gas production, other generators were added. The blue gas was sent to an oil gas bench, where it was carburetted and the oil vapors fixed.

Since all preceding systems had the fundamental disadvantage of being unable to control the quality of the gas, two processes were developed which produced oil gas and water gas separately. These were the Hanlon and Johnson (1878) and the Edgerton. Both systems produced, stored and, in the latter case, metered the oil gas and water gas separately and then mixed the gases cold to produce the desired candlepower. Both systems utilized air under pressure to "blast" the generators, which were twin in series in the Hanlon and Johnson and twin, operated alternately, on the Edgerton.

Other systems with novel ideas were the Meeze, which utilized a specially constructed retort for vaporizing the oil and the early form of Jerzmanowski, which made use of an L shaped retort or "bootleg" filled with limestone.

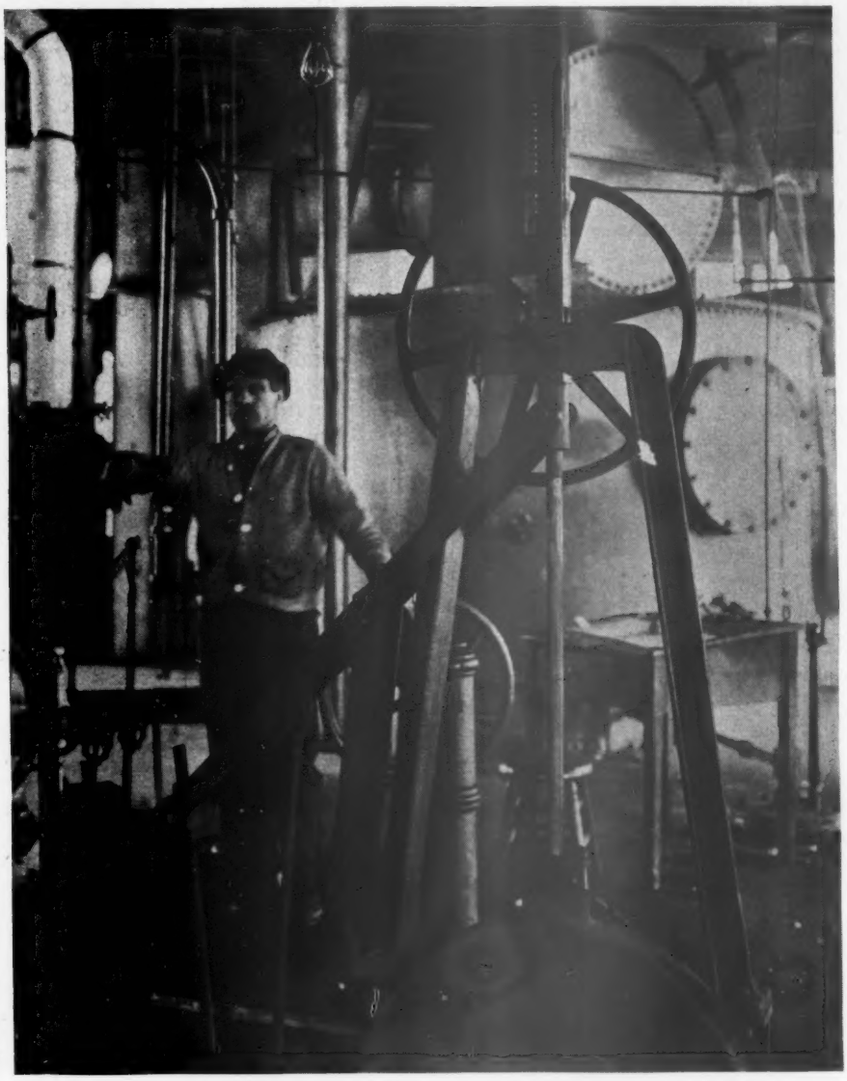
In an endeavor to overcome the intermittent operation of the water gas generator, Egner used a suction producer, and McKenzie a pressure producer. In both cases the producer gas was carburetted with oil which was fixed in the gas by passing it through the usual type of horizontal retort.

du Motay and Wilkinson Apparatus

Two processes which were adopted to a considerable extent were the Tessie du Motay and the Wilkinson. These were very much alike, the only marked difference being the "up and down run" arrangement on the Wilkinson machine, which was the first to possess this valuable feature. Both systems produced blue or so-called "hydrogen" gas, which was stored in a "hydrogen" holder from which it was drawn and then forced through a steam heated carburetter or "illuminator" to pick up the naphtha vapors. The mixture was then passed through retorts to fix the gas.

Although these two systems did good work, they were uneconomical in that they wasted the combustible gas and sensible heat in the generator gas and required the maintenance of a second fire for heating the fixing retorts. They also were limited to the use of naphtha for carburetting.

Prof. Thaddeus S. C. Lowe was the inventor of the most successful form of water gas equipment. This superseded all the earlier forms and is the basis of all modern forms. His apparatus has the inherent characteristics which make for economy and flexibility of operation and for adaptability to a wide range of gas making materials. The successful use of generator fuels, such as anthracite and bituminous coals, coke of all kinds, of carburants, such as gas and fuel oils, and the reforming of oil refinery and natural gas, testify to the adaptability of this system as a means of converting solid, liquid and gaseous fuels into final gases of the desired characteristics.



Hand Operated U.G.I. Set, Baltimore, 1916

As chief aeronaut of the Army of the Potomac, Professor Lowe became engaged in the manufacture of gas for balloons during the Civil War. In 1872 and 1875 he took out patents covering the separate fixing chamber, or superheater, heated internally by combustion of the blast gases from the generator. This use of the blast gases had not been previously conceived and was the basis of all forms of his apparatus and the secret of its success.

The first units erected were of the two shell type and consisted of a generator and a superheater. Primary air was furnished to the base of the generator and secondary air was admitted at the base of the superheater, to burn the generator gases produced during the blasting period. Oil was admitted to the top of the generator fire, was vaporized and was fixed in the superheater in the presence of blue gas which was produced in the generator by steam passing up through the incandescent fuel bed.

The first plant was erected at Phoenixville, Pennsylvania, in 1874. This was followed by others at Conshohocken (1874-5) and Columbia, Pennsylvania (1874-5); Utica, New York (1874-5); Dobson Carpet Mills, Falls of Schuylkill, Philadelphia (1875), Norristown (1875) and Manayunk, Pennsylvania (1875-6). A plant was erected in Baltimore in 1877 by the Consumers' Mutual Gas Light Company, at its Canton Works, and Baltimore thus had the distinction of having undertaken, on a larger scale than any city up to that time, the manufacture of water gas. This enterprise was watched with keen interest throughout the country. The capacity of this installation was 1,000,000 cu. ft. per day and about four years later the capacity was increased to 2,000,000 cu. ft. per day. This plant continued in operation until 1904, when it was closed down as a manufacturing station.

By 1889, Lowe had perfected the three shell or "improved double superheater" type of apparatus, which was the result of converting the gooseneck connection between the generator and the superheater into a "first superheater," while the last shell was called the "second superheater." The latter was made higher so as to provide more fixing surface. In 1891 the "up and down run" arrangement was perfected, which was of tremendous assistance in controlling the generator fire conditions.

Since the year 1889 the alterations in the design of the Lowe apparatus have not been radical. An examination of the sketches of machines built in the year 1909 by the United Gas Improvement Company, the Western Gas Construction Company and the Gas Machinery Company, and by Humphreys and Glasgow (London, England) shows that they all looked pretty much alike. This similarity has persisted to the present day, insofar as the basic form is concerned. Tremendous progress has, however, been made in improving the mechanical details and in increasing the capacity, efficiency and safety of the apparatus.

Although the Lowe form has stood the test of time, a great number of inventors devised apparatus in an endeavor to improve on it. These variations may be classified roughly into four groups, as follows:

1. Single Shell Apparatus, with fixing chamber, or chambers, superimposed on the generator.
2. Single Shell Apparatus, with fixing chamber alongside the generator.
3. Double Shell Apparatus.
4. Twin or Paired Apparatus.

Examples of apparatus composing Group One are as follows:—the Springer, the Pratt and Ryan, the McKay-Critchlow, the Fitch, the Van Steenberg, the Zig-Zag, the Fahnehjelm and the Williamson-Eustace. The latter apparatus was composed of a checkered carburetter and superheater in the upper part of the shell over the generator, the top of which was solid. Oil was sprayed into the top of the carburetter and the vapors and gases passed through an arch to the bottom of and up through the superheater.

Examples of apparatus composing Group Two are as follows:—the Sutherland, the Flannery, the Harris, the Loomis and the Jerzmanowski. In the latter apparatus the superheater was filled with limestone and was set alongside the generator. Oil was sprayed onto the limestone.

Low Pressure Steam Accumulator—Smoot.

The gas produced was low in illuminating value and had to be enriched. The lime was supposed to reduce the percentage of carbon monoxide. A sizeable installation was made at the Chesapeake Gas Company's plant in Baltimore, Maryland, in 1885.

Examples of apparatus composing Group Three are as follows:—the Martin, the Janeway and Banks, the Bates, the Moses, the Economical Gas Apparatus, and the Granger-Collins. In the latter apparatus a checkered superheater was offset and installed above the generator.

Examples of apparatus composing Group Four are as follows:—the Humphries, the Hanlon-Leadley, the Rew and the Rose-Hastings.

Fourth Period—1900 to 1934 — Perfecting of Auxiliaries, Improvements in Economy of Operation and Mechanization of Water Gas Apparatus

During this period, which leads us up to the present time, a great deal of effort, ingenuity and money were spent to secure better control of the operation of the water gas set, to reduce the labor cost in operating and to improve the flexibility and economy of operation.

Steam and Air Flow Meters and Pyrometers—The first forward step was made about 1907 with the application of steam and air flow meters to measure the quantities of air and steam delivered to the set. The use of pyrometers was also begun and with this new knowledge real progress was made toward securing more efficient operation and utilization of manufacturing materials. This information also paved the way for a study and consequent improvement in design, which provided for larger gas, air and steam connections, and also showed the advisability of using higher blast pressures. All of these changes resulted in higher set capacity. Improvements in the instruments and gauges used provided better information because of their ruggedness and reliability.

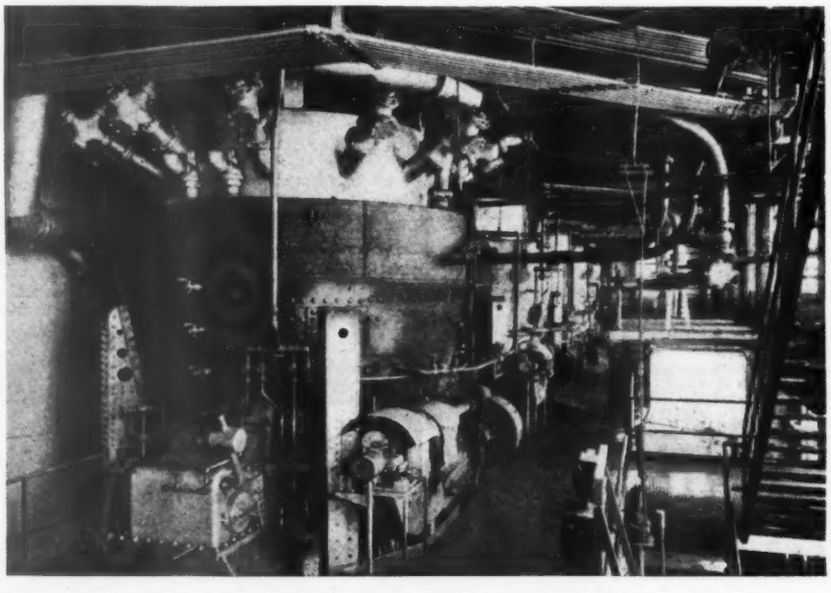
Hydraulic Operation—Prior to the year 1914 all of the functions of the water gas set were hand operated. It was necessary for the operator to proceed from one lever or geared hand wheel to another in order to open or close the air, steam, oil and stack valves. This consumed considerable time which was lost as gas making time. In order to reduce the lost time and the laborious work required, hydraulic cylinders were installed to operate the valves, the levers and control valves being grouped and located at a convenient point. The Critchlow "nest" of valves is perhaps the outstanding example of such grouping and was perfected and widely installed during the years 1915 and 1916.

Automatic Controls—The next logical step was an endeavor to operate the hydraulic control valves mechanically. Records indicate that the originator of this idea was C. F. Zeek, who experimented on and finally installed his device, which is the forerunner of the U. G. I. automatic control, on one of the five foot sets in his plant in 1913. This home-made device utilized a counterweight to furnish the power and a pendulum for timing. In 1915 Taussig, of the U. G. I. Company, invented and patented an improved control which used a clock and timing pendulum.

An electric motor was substituted for the clock and the control further perfected, so that by the year 1920 the "Type A" U. G. I. Control was being installed in a great number of plants to automatize the operation of the Critchlow hydraulic control "nest."

The development of this piece of equipment was followed by the Shaw (Bartlett-Hayward Co.) automatic, pneumatic, electric control, the Gas Machinery Company's automatic,

(*Continued on page 147*)



U.G.I. Mechanical Generator at Chester, Pa.

1832 — BARTLETT HAYWARD — 1934

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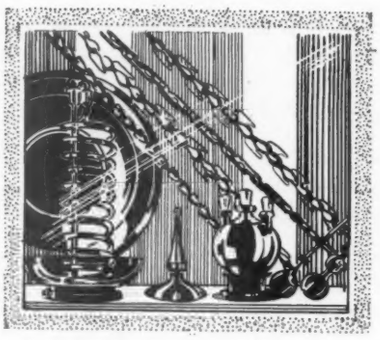
Seventy-Five Years Progress in Gas Analysis



By A. W. JOYCE, Ph.D.
Consulting Chemist

AN interesting commentary on the progress in the development of the manufactured gas industry during the past seventy-five years is the fact that the methods used today for the analysis of the more important constituents of gas are based upon fundamental chemical principles which were known and adopted as a basis for analysis by gas chemists when the *American Gas Light Journal* was first issued in 1859. It is of course true that refinements in the methods have been made, and the chemist of today has little trouble in handling gases and determining their correct volume. In the early days the problem of dealing with gases and measuring them was a most difficult one. They did not have suitable apparatus for accurate work and when an apparatus was devised it was delicate and the duration for carrying out analytical operations was so long that routine analysis of the gas was out of question.

Lack of Chemists

At this time hardly a single gas company had a chemist and laboratories at gas works were almost unknown. With few exceptions the only gas manufactured was plain coal-gas and it was manufactured, more or less, by rule of thumb. More emphasis was placed upon the measuring of the illuminating power of the gas than upon its analysis, but for this reason more and more work was done on the investigations of the constituents of coal-gas, the elimination of sulfur compounds and means for doing this. The well known Referees test for sulfur, which is the accepted method today, was in use in 1859 and was required by the Referees in England of that day.

The chemistry of the constituents of coal-gas in those days was based largely upon the classical researches of Bunsen, who published in this period his methods for the analysis for gases. Investigators of this period knew that coal-gas comprised a mixture of oxygen, hydrogen, nitrogen, carbon monoxide,—known then as "carbonic oxide,"—carbon dioxide,—known as "carbonic acid,"—water, ammonia, methane,—known as "light carburetted hydrogen,"—olefiant gas, acetylene, light and heavy hydrocarbons, hydrogen sulfide, carbon bisulfide, cyanogen, ammonium thiocyanate and other sulfur compounds.

The accurate analysis of coal-gas was considered one of the most delicate operations of the chemistry of the day. For this reason it was hardly ever used in the gas works, and the testing of gas was confined to the determination of the presence of impurities, such as the presence of hydrogen sulfide by means of a strip of paper saturated with a solution of lead acetate, or testing for ammonia in the gas with either turmeric or litmus paper. Methods of testing for carbon bisulfide were very unsatisfactory and a great many tests were devised which were for the most part unsatisfactory, but it is of interest to note that the trithylphosphine method for the determination of carbon bisulfide, which was discovered by Hofmann was recommended as early as 1868 in Clegg's treatise on the manufacture of gas. The detection and elimination of sulfur compounds gave early investigators much trouble, but they used the Referees method for the determination of total sulfur which has withstood the test of time and is still the preferred method for this test.

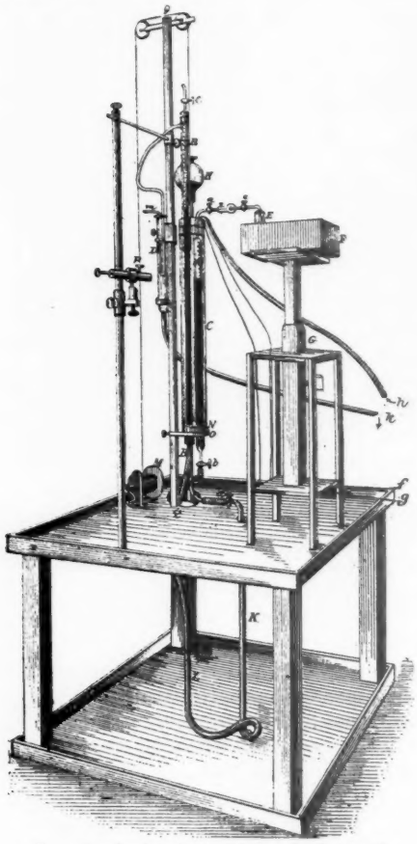
Analysis Routine

It is doubtful if any of the gas-works of 1859 used Bunsen's scheme for the analysis of gases, because as stated before there were few chemists in the gas-works and with these routine analysis of gas was not practised, not so much because of inadequate methods but chiefly because the methods of analysis required a great deal of time and very careful manipulation. Analytical operations on gases were for the most part conducted over mercury and the gas was always dried if water had been introduced or formed in the reactions involved, and corrections in volume had to be calculated from the pressure and temperature. Eudiometers or measuring tubes used for their analyses, which had been calibrated and graduated in cubic inches and tenths of cubic inches, were filled with mercury, inverted in a trough of mercury and a definite volume of the gas to be analysed was introduced. The oxygen, carbon dioxide, carbon monoxide, illuminants and hydrogen sulfide were determined volumetrically by introducing a small quantity of a suitable reagent which would absorb one of the gaseous ingredients, and the change in volume of the gas was noted. The analysis was carried out in the following manner: In order to determine the carbon dioxide in the gas, a pellet or ball of solid caustic potash was fastened to the end of a platinum wire and introduced into the gas by plunging it into the mercury and up into the measuring tube. It was allowed to remain for one hour in contact with the gas and then withdrawn, and the change in volume determined.

Determination of Oxygen

Oxygen was next determined with Potassium pyrogallate in the same manner, and a very ingenious method for the preparation and introduction of this reagent was used. A test-tube filled with mercury was inverted in the trough near the gas measuring tube. A small quantity of a strong aqueous solution of pyrogallic acid was introduced into the test-tube followed by a similar quantity of a strong solution of caustic potash. The potassium pyrogallate was thus formed protected from oxygen. A small ball of coke was now fastened to the end of a platinum wire, introduced up into the test-tube and allowed to absorb the pyrogallate solution. It was then withdrawn and, while keeping it under

the mercury, passed into the measuring tube and up into the gas confined therein. After about a half hour the reagent was withdrawn, but now some moisture had been given to the gas and it had to be dried by introducing a ball of caustic potash, before the contraction in volume could be noted.



Gas Analysis Apparatus of about the Year, 1860.

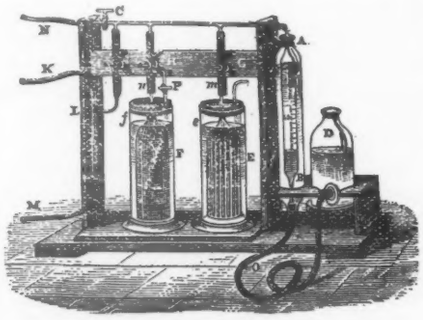
For the determination of the volume of olefiant gas and illuminants a fresh ball of coke was soaked in some fuming sulfuric acid and introduced quickly under the mercury into the gas. It was allowed to remain in the gas for two hours and then withdrawn. The gas was now contaminated with acid ingredients and the residual sulfur dioxide and trioxide were absorbed by introducing a ball of freshly prepared manganese dioxide which was moistened, thus introducing moisture which had to be eliminated by means of a ball of caustic potash. Clegg claims in his treatise on the manufacture of gas in 1868 that this method for the determination of luminiferous constituents seldom varied more than 0.1 to 0.2%!

Carbon monoxide was determined by a similar procedure using a ball of coke saturated with a hydrochloric acid solution of cuprous chloride. However, the early workers did not think that this method gave an accurate indication of the amount of carbon monoxide present and preferred to determine this ingredient indirectly by exploding the residual gas, after absorbing the oxygen and carbon dioxide, first with oxygen and them with hydrogen. If hydrogen sulfide had not been removed from the gas taken for analysis, it was determined before anything else by absorption with a papier maché ball saturated with a mixture of manganese dioxide and phosphoric acid.

For the determination of methane, hydrogen and sometimes carbon monoxide the residual gas which was now dry was saturated with water by introducing a drop of water. A measured volume of oxygen was now introduced and the mixture exploded. The carbon dioxide formed was then absorbed with a ball of caustic potash. From the volume of carbon dioxide and the contraction which the total volume of the gas suffered, as representing the resulting quantity of water, the respective amounts of hydrogen, methane and nitrogen originally present were calculated. If carbon monoxide was determined by explosion, the residual gas after the explosion with oxygen was mixed with hydrogen and a second explosion made.

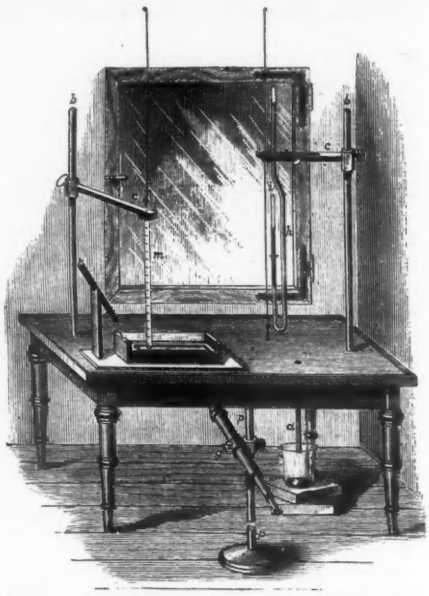
It can readily be seen that a great drawback in the use of this scheme of analysis was the length of time necessary for the different absorptions, the cooling of the gas to room temperature and the calculations that were required.

Gradually the advantages of chemical analysis and chemical methods of control for the gas-works became more and more apparent, not only to make it possible to introduce economical improvements into the manufacture and to provide purer gas of higher illuminating power, and to secure all valuable by-products, but also to meet the increasing demand on the part of consumers, and more particularly, legislators, for cheaper gas.



Very early type of Orsat Apparatus—1874.

Improvements in the apparatus for the analysis of gas were made by a number of investigators. One of the earliest forms was an apparatus introduced by Franklin and Ward in the late sixties.



Bunsen and Roscoe's Gas Analysis Apparatus—about 1858.

This apparatus consisted of two long tubes connected together at one end, one for measuring the gas and the other used as a barometer tube, both tubes being inclosed in a larger tube filled with water to maintain a constant temperature. One end of the measuring tube is connected with an inverted bell-glass in a trough of mercury wherein the gas is led and absorbents introduced by means of a pipette having a curved point. This apparatus enabled an analysis to be made in less time than heretofore but it still left much to be desired. An ordinary analysis could be made in three hours and calculations required another half hour. Improvements and modifications of this apparatus were made and other types came into use about 1870, such as Winkler's and Bunte's gas-burettes.

Up to this time gas analysis had not yet been assigned a place among the resources of industrial practise, and this may be attributed partly to the difficulty of dealing with gases and measuring them, and partly also to the delicacy of the laboratory apparatus employed and the duration of the analytical operations.

In 1874 H. M. Orsat devised an apparatus which was developed from an earlier principle supplied by Regnault. While this early Orsat was soon improved its use made it possible to dispense with the pneumatic trough of water or mercury,

(Continued on page 152)

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And the birds are singing
Don't forget your recent cold weather
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Development of Field Practice in The Natural Gas Industry

Stone and Tablet marking site of First Natural Gas Well at Fredonia, N. Y., 1825.

By JOHN R. REEVES
Penn-York Natural Gas

IN THE United States the use of natural gas in commerce probably originated at Fredonia, N. Y., in the early part of the 19th century.

Gas seepages in the valley of Canadaway Creek near this village lead William A. Hart, in 1821, to drill a well in an effort to obtain a supply of gas large enough to be of practical use. This well was drilled to a reported depth of 70 feet where a "vein" of gas was found. Hart immediately began its utilization by constructing a gasometer in which to collect the gas and laying a three-quarters inch lead pipe to the nearby hotel and stores where it was used for illumination.

Within the next 50 years in Ohio, Pennsylvania, New York and West Virginia gas in larger quantity was found in wells of greater depth. It was transported by iron and wood pipe lines and made use of commercially, chiefly for lighting.

By the year 1900 natural gas was being produced and consumed on a large scale in New York, Pennsylvania, West Virginia, Ohio and Indiana. In the search for oil in the 80's and 90's enough gas became available to attract commercial users as a cheap fuel. This in turn prompted a further effort to find more gas. Since that time gas has been found and utilized in many other states, the principal producers other than those mentioned above being Kentucky, Kansas, Oklahoma, Texas, Louisiana and California.

In the early days natural gas was commonly believed to occur beneath the surface of the earth in "veins, pools, lakes and otherwise." Surface features such as springs, streams, hills, soil and vegetation were thought to be expressions or indicators, if properly interpreted, of the presence of gas beneath the surface. Consequently, many and varied were the reasons for drilling wells at particular locations. Without considering the merits of the early wildcatter's reasoning his faith was sufficiently rewarded, for by 1890 there were thousands of producing gas wells and large parts of Pennsylvania, Ohio and West Virginia were known to be gas bearing.

Prior to 1900 Dr. I. C. White, State Geologist of West Virginia, had noted that oil and gas were found more commonly than elsewhere on that type of structural deformation of the earth's strata known as an anticline. With a knowledge of underground conditions, especially of porous strata that might contain fluids as water and oil or gas, he evolved the anticlinal theory of the accumulation of oil and gas. Little practical thought was given this geological theory prior to 1913 since when, it has been enlarged upon and other subsurface conditions found which also control the accumulation of oil and gas. It is at present recognized that the anticline in one form or another is the most likely place to find new oil and gas fields and from them has been produced most of our past supply of these essential products.

The earliest general application of geology in exploring for oil and gas consisted for the most part of studies of surface features such as finding and mapping anticlines, salt domes, faults and other structural forms.

This type of work was begun more generally in Kansas, Oklahoma and Texas but has since been carried on in nearly every state.

It soon became evident that the use of geology could be extended profitably by knowledge and consideration of subsurface conditions where they could not be interpreted by the surface or from drilling. This gave rise to the wide use of the core drill, magnetometer, seismograph and torsion balance in geological exploration.

Geology also has been of great use and importance in working out various field developments such as casing shut-offs, water problems, penetration of the producing horizon, as well as many others.

Knowledge of Gas Reserves

Nearly all of our knowledge of the estimation of gas reserves has been developed in the past 25 years. Prior to this time the amount of gas any new field would produce was problematical and consequently the product was produced and consumed with a large element of risk. As new fields were found the advantage of a fore-knowledge of the quantity of gas available which would permit a profitable investment in its production and marketing became increasingly obvious.

Two methods of estimating reserves have been developed and proved of service, the accuracy of each being subject to the correct fundamental data on which it is based. The production - pressure decline method has the disadvantage of requiring production statistics for a year or more before it can be used. After a field is two or three years old or more, this method is quite reliable for estimating future reserves. The saturation method may be applied before any gas has been produced and requires accurate information of the porosity of the producing formation, the thickness of the "pay" and its areal extent as well as the closed in pressure of the wells. Because of the difficulty of obtaining accurate data the latter method is usually subject to greater error than the first.

Thus, the answer to the old question of how long a gas field will last is now supplied by two factors, the quantity available and its rate of withdrawal.

The capital invested in the natural gas industry in transportation systems, wells and markets and the responsibility of maintaining a sufficient supply of gas for these markets has made imperative the maintainance of adequate reserves. To maintain these reserves a continuous search for new gas fields must be and is being constantly carried on.

Two methods of drilling for natural gas are in common use, namely, the percussion method in which cable tools are used and the hydraulic in which rotary tools are employed. It is assumed that the reader is familiar with the principles involved in both these methods of drilling and they will not be explained.

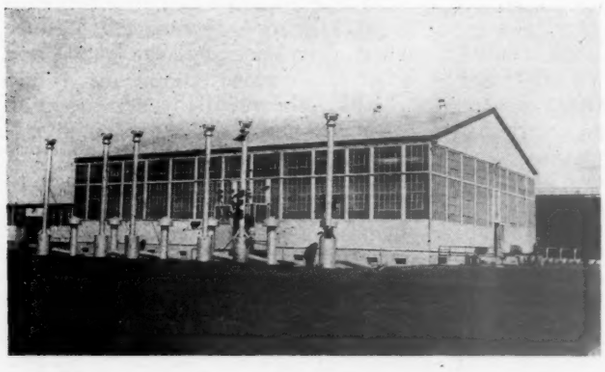
The cable tool method of drilling was known before the commercial use of natural gas began. The first conception of drilling a hole to find gas naturally combined this type of drilling. Early drilling by this method was limited in size and depth of hole by the crude tools then in use. As necessity called for larger and deeper holes, tools, lines and surface equipment were improved to meet the added requirements. In 1890 a well 2000 feet in depth was considered a deep hole; in 1925, 3500 feet was generally termed deep cable tool drilling; today gas wells are commonly being drilled 5,000 feet deep or more and many wells have been drilled to much greater depths with cable tools. This method of drilling is used almost exclusively east of the Mississippi River and widely in the Mid-Continent and Rocky Mountain states.

The rotary method of drilling is of comparatively recent origin and its development was brought about in drilling soft caving formations where cable tools were unsatisfactory. The spread in use and improvement of the rotary method of drilling has been faster than the cable tool and today it is used almost exclusively where soft formations are found and where greater depths and high pressure formations are to be drilled. This method is used most widely in California, Texas, Louisiana, Arkansas and Oklahoma.

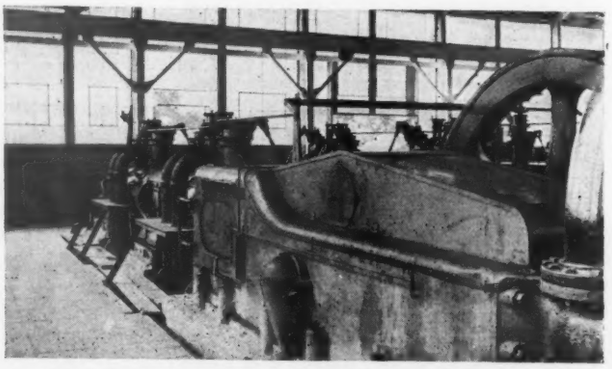
Factors Influencing Drilling

Modern use of either one of these methods of drilling is no longer a matter of preference but of cost, and to a lesser extent, drilling time required in reaching the objective. Some factors to be considered in selecting either one of these methods are: cost of equipment, casing required, drilling time, fuel and water, safety in completing high pressure wells and the relative effectiveness in actual drilling. Generally the rotary method of drilling requires much more expensive equipment, less casing, less drilling time for depths greater than 4,000 feet, more fuel and water, is safer and more effective in drilling high pressure formations and is practically indispensable for drilling soft, caving and shifting formations. Improvements in rotary drilling equipment have been such in the past few years that hard formations can be drilled as readily as with cable tools.

Casing was first used primarily to prevent water encountered in drilling from entering and damaging the producing sand. As deeper wells became common, casing was found to be of advantage in shutting off water so that drilling could be carried on with greater efficiency. Modern usage of casing combines these two functions as well as a third, that of acting as a carrier of oil or gas to the sur-



A large modern Compressor Station in the Monroe, La., Gas Field. Exhaust side, main building, with cooling tower and auxiliary building in background.



Type of 1250 direct connected gas engine driven Compressor Units used in large modern Compressor Station in Monroe, La. Gas Field—looking toward power end.

face without loss or damage to the well or other producing formations above the one in which the well is completed.

Cast iron, bell and spigot pipe, wood conduits and sheet iron tubes were used early for shutting off surface waters; in fact the last two above mentioned are still satisfactorily used in certain localities. More commonly the modern surface string is composed of relatively light weight seamless or lap welded steel casing except where "driving" is necessary in which case, heavy seamless steel drive pipe is preferable.

From water and producing strings of casing of soft iron a few hundred feet in length used in 1865 we have progressed to high tensile strength, seamless, special collar, steel casing that is safely being used at depths greater than 8,000 feet. From our first shallow wells with 5-inch surface pipe and a 3-inch producing string of casing we now frequently begin with 20-inch surface pipe, use 4 water strings and finish the well with a 6-inch producing string of casing.

Completing Gas Wells

One of the most common methods of completing gas wells has been to run a string of 2-inch or 3-inch tubing with a packer and pull all but the surface casing. In some areas this is still a satisfactory and economical method for small wells under certain conditions. Wells so completed are difficult to handle once water makes its appearance or salt begins to deposit in the tubing. Furthermore, once the tubing parts, the cost of repairing is generally too great for the values involved and the well is lost. More modern usage in completing gas wells of greater size and depth provides for 6-inch or 7-inch casing set and cemented on top of the producing sand. The casing may be used as a production string or the well may be tubed. Such usage allows greater volume and control of production, more latitude in control of water and salt, and the well is more easily repaired, should it become necessary.

Casing shut-offs of top water have always been one of the operator's most vexing problems. Depending upon the conditions of the hole, this has been accomplished in various ways. The most common method is simply to set down the casing with its shoe in a slightly restricted hole. After the casing is run, and before it is set down, mud may be circulated around the casing and the casing then set. A third and more certain method requires the placing of cement in variable quantity behind the casing by circulation or otherwise, the casing then set and the cement allowed to harden.

When the shut-off is to be made in a hole where there is no shoulder seat, packers of various types are used. One of the earliest known packers consisted of a bag of flax seed which, when it came in contact with water, swelled and made the shut-off. Many other kinds of expansion packers have been made and used, rubber being the chief expanding material. For such shut-offs, bridging the hole and cementing is also used effectively.

Surface Control

Surface control of gas wells consists of the actual equipment used to shut in the well and the flowing equipment. The size, type and extent of the control equipment varies with the pressure, volume and special conditions, if they exist.

Wells of moderate size in open flow and rock pressure and producing dry gas, require no particular equipment or methods of handling the flow. However, when large volumes and high pressures are encountered, particular care must be used in selecting and installing equipment that meets specifications of safety and performance. Space does not permit a discussion of control equipment and methods.

The measurement of natural gas in the early stages of the industry was unnecessary, as the product was sold on a flat-rate basis. As gas became more valuable and its use increased it became necessary to sell and buy on the basis of the amount consumed. This necessity brought about the development of another important phase of the natural gas industry, that of measurement.

Solids and liquids are ordinarily measured so simply that little thought is given to the subject. The measurement of the flow of natural gas, sensitively subject to fluctuating conditions of temperature and pressure, is an entirely different matter and calls for practice of the highest skill. To a few men in the industry must go the credit for succeeding so well in their basic studies that the principles of gas measurement are no longer questioned.

Three methods of open flow measurement of gas are employed principally in measuring the volume of flow of wells. They are the minute pressure, orifice and Pitot tube. The first is more a method of estimation than measurement, the second is a recent adaption and is used for small wells, while the Pitot tube is best known and most widely used.

Closed flow measurement of natural gas is done chiefly with the positive type of meter for small flows and the orifice type for large flows, however, Pitot tubes, Venturi, electrical and proportional meters are also used.

The positive gas meter was invented and the principles of the Pitot tube known before their use was required in measuring natural gas. The orifice meter was invented in 1911 as a result of the need for better meters for measuring natural gas. So successful has been the development of this type of meter that it is of almost universal use where large quantities of gas are being measured.

Probably natural gas was first transported in this country in the ¾-inch lead pipe of Wm. A. Hart at Fredonia in 1821. In 1872 a natural gas pipe line constructed of white pine of 8-inch inside and 12½-inch outside diameters, 25 miles long was laid from West Bloomfield to Rochester, N. Y. In 1873 Titusville, Pa. was being served with gas from a 2-inch iron pipe line 5 miles long. By 1900 it had become the practice to transport gas at relatively high pressures in iron pipe with screw couplings. An 8-inch line was then considered of large size. Within 35 years we have advanced to lap-weld, electric weld and seamless steel tubing that can transport gas at 1,000 pounds pressure, screw couplings have been replaced by the more satisfactory patent couplings and welding, steel is being treated to prevent corrosion and lines have reached a diameter of 26 inches, length of 900 miles and of carrying capacity of 175 million cubic feet daily.

Gas Goes to Consumer

The consumption of natural gas first developed in the vicinity of the source of supply. Industrialists desiring this ideal fuel moved their manufacturing operations to the gas fields. As the product became more plentiful and opportunities for profit more apparent, the practice of taking gas to the consumer began. Today gas is taken to the consumer wherever he may be located if it is available and economics permit.

The compression of natural gas has been the direct outgrowth of the necessity of increasing the flow of gas through pipe lines, and in low pressure producing areas of getting the gas into high pressure transmission lines. The principle of operation of the early type of compressor is

(Continued on page 60)

SIXTY YEARS OF PROGRESS

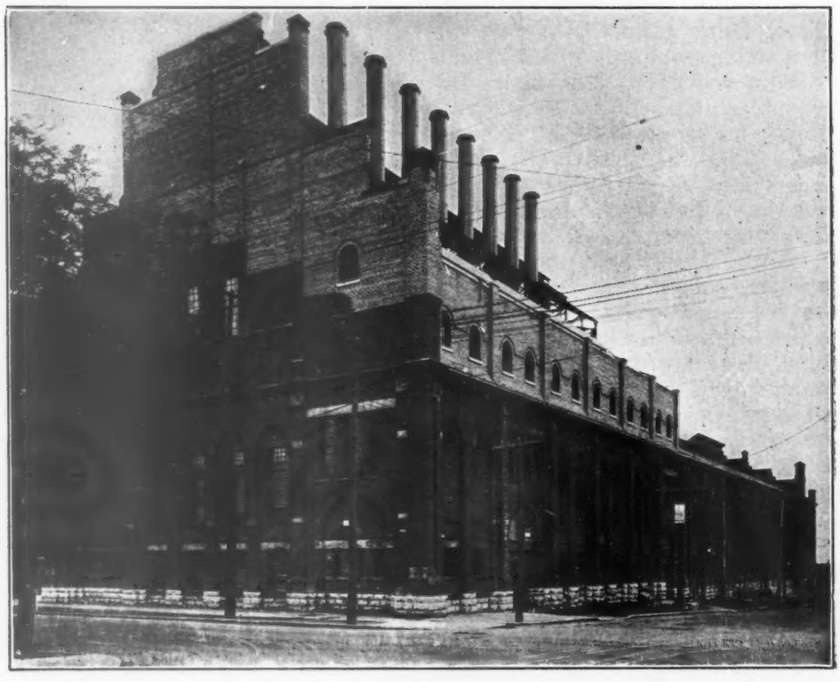
1874-1934

NOTHING could show more graphically the tremendous progress that has been made in coal carbonization and the important part the West Gas Improvement Company has played in the development of this phase of the gas industry, than the two accompanying photographs.

The one on the left shows the first charging machine in the gas industry and the other a recent installation of Glover-West continuous vertical retorts.

Services of our engineers are available in connection with any coal carbonization problem.

John West, founder of the Company, is shown standing in the above photograph. He built the first charging machine in the industry and was the inventor of almost all the early labor saving devices. His policy is still being continued in the company's equipment and is exemplified in the thirteen bench installation of Glover-West continuous vertical retorts at Toronto, Ontario, Canada, which is shown in the photograph on the right.



WEST GAS IMPROVEMENT COMPANY OF AMERICA, INC.

Builders of Coal Gas Plants

424 MADISON AVENUE NEW YORK, N. Y.

Development of A Substitute Gas For Natural Gas

By HENRY O. LOEBELL

Vice-President, Combustion Utilities Corporation

A recent standby installation at Memphis, Tenn., showing the operating fl of a fully automatic former Steere set converted to the Refractory Scr Oil Gas Process. This is one of two 11' 0" sets so converted

THE EXPANSION of the natural gas industry created two problems whose solution necessitated the services of manufactured gas technologists.

The first of these related to the always expensive peak loads. While progress in reducing the costs of construction enabled natural gas lines to serve the base load cheaper than it could be manufactured, it did not reach a point where industrial gas could be economically served on a continuous basis. This necessitated that natural gas companies expand into the househeating field in order to secure the volume essential to their economic success.

However, the househeating load brought with it a peak load which has no equal in any other class of business served by a gas utility. Obviously this peak had to be met, but it could not be economically met by pipeline capacity.

Problems to Be Solved

It appeared, however, that if manufactured gas could be economically produced to carry these peak loads the problem could be solved. In this event a high load factor could be maintained on the pipeline and a low unit cost would result with a minimum volume of industrial sales.

The second problem which developed related to the protection of service. The manufactured gas industry had established an enviable record of continuous service. Interruptions due to a failure of supply were virtually unknown.

Because of this record, such manufactured gas companies were reluctant to place their confidence in a single pipeline extending hundreds of miles to the source of supply.

Obviously, holder capacity could not be installed economically to provide for an emergency which might or might not occur. However, if a successful process for manufacturing peak load gas could be developed, such a process would provide the protection to service which the utilities require.

Natural Gas Substitute

Hence it became desirable to develop a process for producing a gas which could be substituted for natural gas without affecting service. Such a gas had to have similar burning characteristics as natural gas so that satisfactory performance could be obtained in all domestic appliances. The mere duplication of heating value and gravity, though desirable, is no direct criterion of satisfactory performance.

The process had to be such as to permit the production of gas within three hours or less after starting. This was necessary because a break in the supply line might occur at the town border and few companies have sufficient gas in storage to tide them over a longer period.

It was also necessary that the process be simple in order to preclude the necessity of keeping a large force of trained men on hand, which during periods of standby would permit the operators to be employed in other useful work.

In addition to these requirements the process should, if possible, be adaptable to existing generating equipment so that conversion or installation costs can be kept to the minimum and high unit capacity with moderate production costs be obtained.

It had already been demonstrated that augmentation of natural gas supply can be obtained, for example, by a butane enriched water gas but the complete substitution of such gases for natural gas was even then generally recognized as impractical.

With these requirements and examples in mind a group of engineers several years ago set out to develop a process to meet them.

These men explored many possibilities and experimented with many methods. Ordinary water gas was enriched with gas oil and with butane. Heavy fuel oil was cracked in coal and coke beds and many processes were developed, some of which were good and some of which were complete failures. Finally, however, they hit upon a process of cracking fuel oil in a generator on a refractory bed, the heat of which was maintained by the combustion of carbon deposited from the breaking down of the oil. The resultant gas was then enriched by gas oil in the carburettor to almost any desired heat content.

Wide Thermal Variation

This process was first demonstrated publicly in 1932 to a number of interested people in Cleveland, Ohio, and it seemed to meet every limitation imposed upon it.

Gas with a heat content ranging from 550 BTUs per cubic foot to 1200 BTUs per cubic foot could be made at will and with a wide range of specific gravities. This gas was successfully used by itself in various domestic appliances and was also successfully used when mixed with various percentages of natural gas.

By inserting oil burners with which to heat up the refractory bed, the

generator, the carburettor and the superheater could be placed in production within two or three hours from cold.

As the process used oil alone without any coal or coke, man power was reduced to a minimum. The operation was simplicity itself when once the cycle for a given installation had been definitely fixed.

The oil requirements were exceedingly moderate and no troublesome by-products resulted. The process was adaptable to almost any standard water gas set with only a few minor changes and the volumetric capacity even when producing high BTU gas was at least the equivalent of the set when formerly making low BTU carburetted water gas.

Every Requirement Met

The process thus met every requirement established for it and moreover it used oil exclusively, which eliminated the waste resulting from the handling and storing of large coal or coke standby stocks.

Upon the public announcement of this process numerous other investigators entered the field. As a result there are today available a number of commercial processes suitable for the production of peak load gas. In the course of these developments valuable contributions have been made and today the problem has been solved.

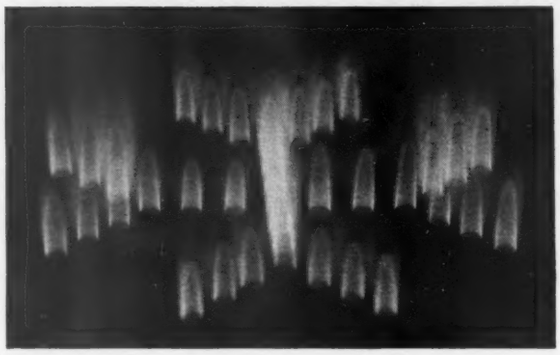
The conversion of two 11 feet 0 inches diameter sets at Denver and the part they played in the emergency created by the washout of the natural gas line is a matter of record.

Similar conversions have been completed at Memphis and three machines are in process of being tested at New Orleans. These examples conclusively demonstrate the value of such protection to the utility companies and likewise that a satisfactory process has been developed and is available to the industry.

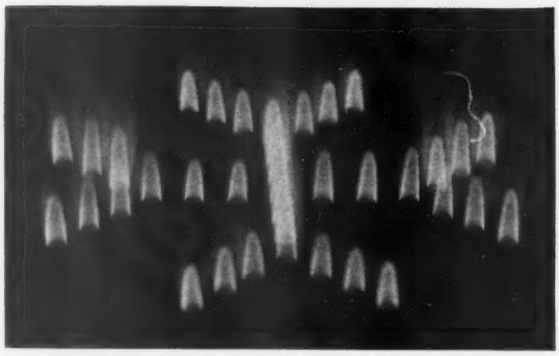
While protection of service is no doubt its greatest asset today, this process will undoubtedly contribute to the economics of pipeline transportation because with the return of prosperity the increasing loads and higher costs of serving peak gas must be met. Hence, natural gas companies, as well as utilities, can well afford to investigate its possibilities as an alternative to constructing loops or compressor stations.

It is not to be expected that this phase of gas production has reached its ultimate degree of perfection. Doubtless improvements in processes and equipment will continue to be made in the years to come. Of major importance, however, is the fact that development work has passed beyond the experimental stage and a proven process is available to all companies requiring it.

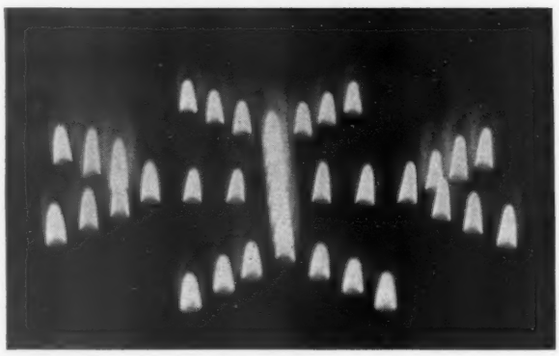
Flame Characteristics various types gases



Burning 100% oil gas 1012 B.t.u, .698 sp.gr.



Burning 50% oil gas, 50% natural gas 1070 B.t.u., .674 sp.gr.



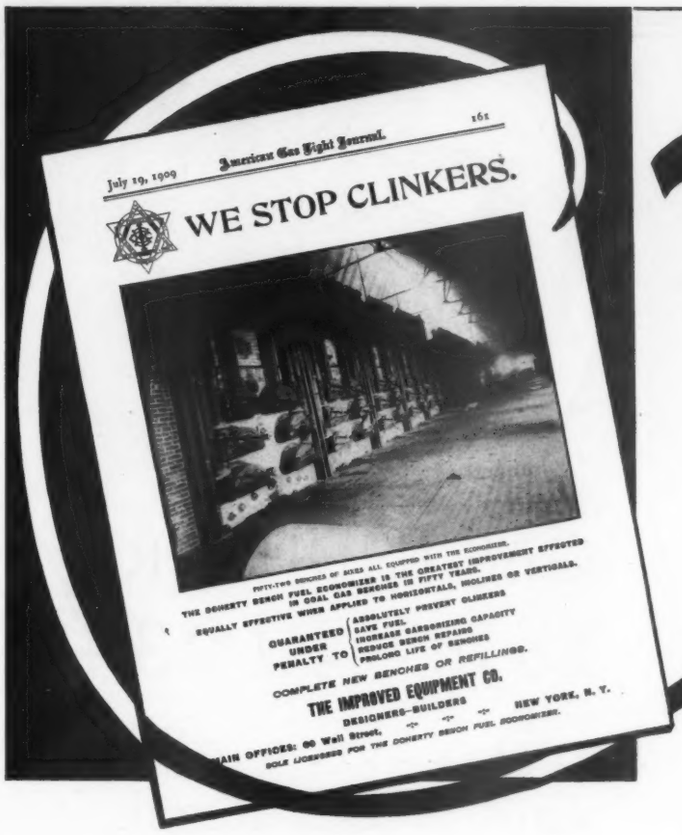
Burning 100% natural gas 1130 B.t.u., .650 sp.gr.

Development of Field Practice in The Natural Gas Industry

(Continued from page 57)

identical to that of the single stage compressor of today. Mechanical and operating refinements have been and are still being made, one of these being the multi-stage compressor unit. Without compression it would be impossible to transport gas for long distances.

The development of field practice in the natural gas industry has made great advances in the last half century. Today is no culmination or peak of achievement but merely a stepping stone to tomorrow. Profit, even as necessity, is the mother of invention, therefore just as certainly as field practice has improved so will it continue to improve, and the reader of the centennial anniversary number of the *American Gas Journal* no doubt will read of still greater achievements and progress.


July 19, 1909 American Gas Light Journal. 161
WE STOP CLINKERS.
THE DOHERTY BENCH FUEL ECONOMIZER IS THE GREATEST IMPROVEMENT EFFECTED IN COAL GAS BENCHES IN FIFTY YEARS.
EQUALLY EFFECTIVE WHEN APPLIED TO HORIZONTAL, INCLINED OR VERTICALS.
GUARANTEED UNDER PENALTY TO
ABSOLUTELY PREVENT CLINKERS
SAVE FUEL
INCREASE CARBURETING CAPACITY
REDUCE BENCH REPAIRS
PROLONG LIFE OF BENCHES
COMPLETE NEW BENCHES OR REFILLINGS.
THE IMPROVED EQUIPMENT CO.
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SOLE LICENSEES FOR THE DOHERTY BENCH FUEL ECONOMIZER.

25 YEARS AGO

WHEN the 50th Anniversary issue of American Gas Light Journal was published, The Improved Equipment Company was introducing to the gas industry the Doherty Bench Fuel Economizer—still the most effective equipment for its purpose.

TODAY—

THE REFRACTORY SCREEN OIL-GAS PROCESS

developed and introduced by us some time ago to economically provide adequate stand-by and peak load requirements of natural gas distributors, maintains our position abreast of the industry—

WITH this process, the use of solid fuel is eliminated. Existing carburetted water-gas equipment can be utilized without decrease in volumetric capacity. The equipment can be started quickly, and gas turned into the mains within a few hours. The low gravity, high B.t.u. gases which can be produced require no burner adjustments when substituted for various natural gases.

When the Refractory Screen Oil-Gas Process is employed, gas manufacturing equipment becomes a useful part of the natural gas distributing system and the investment therein may rightly be retained in the rate-making structure.

The combined facilities of this Company and of Combustion Utilities Corporation, by whom the process was developed, are available for engineering, design and installation of conversions or of new equipment for this process. Information concerning it or concerning our installations at Denver, Memphis ad New Orleans will be furnished on request.

IMPROVED EQUIPMENT-RUSSELL ENGINEERING CORPORATION

24 State Street **New York**

58 YEARS OF SERVICE— CONNELLY TO THE GAS INDUSTRY 1876—1934

IRON SPONGE for Purification of Gas
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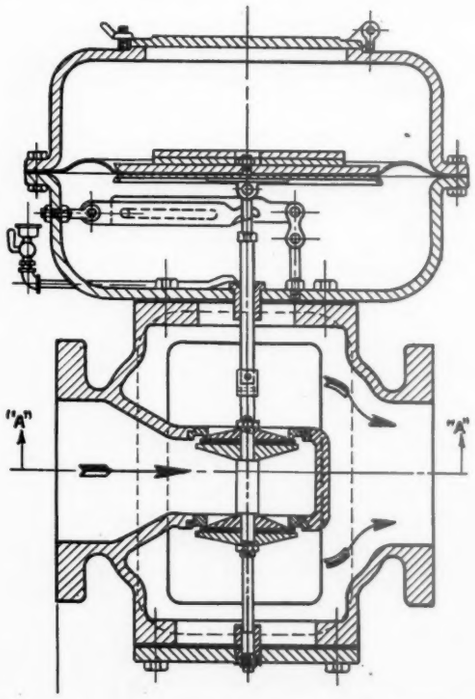

Connelly style L. C. District Governors have the novel feature of compound levers that are adjustable to increase or decrease the diaphragm power and valve travel and thus will accommodate a very wide range of pressure and volume conditions. An unusually large side plate is provided for ease in access to working parts for removal, cleaning and repairs.

Connelly Governors are universally acknowledged the most satisfactory regulating devices for the control of high and low gas pressures.

THE American nation was celebrating its One Hundredth Birthday and American Gas Journal its Seventeenth when we began to help the gas industry to make purer gas and to distribute it more economically and with greater safety.

During the ensuing 58 years we have, through our experience and direct contact with the industry, kept abreast of the immense progress made in the gas field and have improved our product to meet the changed conditions.

Considerable investment in new facilities has recently been made at our Elizabeth plant so that "IRON SPONGE" having greater capacity and higher activity can be produced there.

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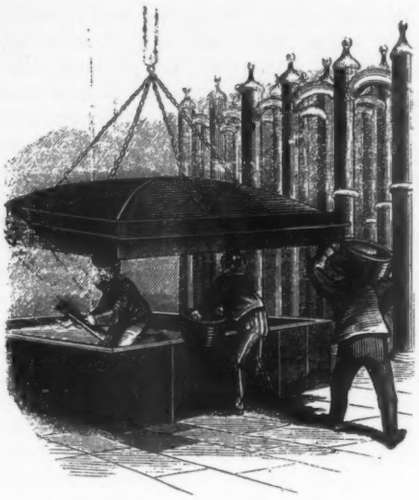


The Purifying Room in The Philadelphia Gas Works, in the late Fifties.

Developments in Condensing, Scrubbing and Purification of Gas

By R. C. DOWNING

Sup't. of Manufacture Lowell Gas Light Company

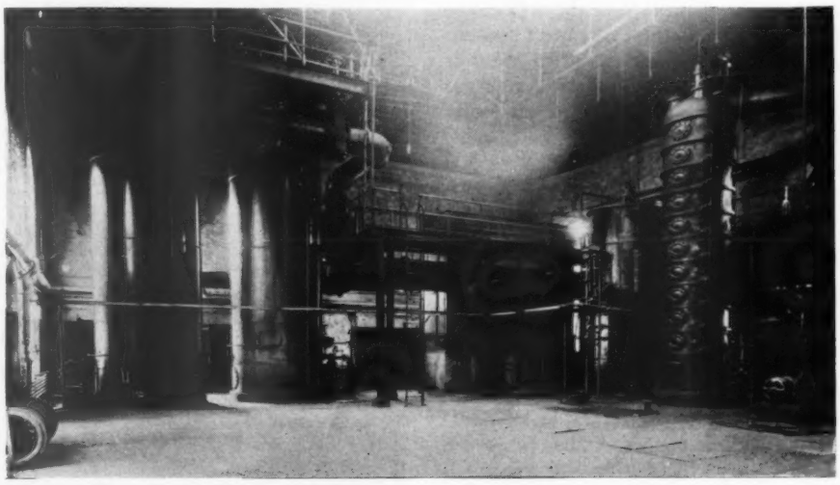
SEVENTY-FIVE years ago, when the first issue of the *American Gas Light Journal* went to press, the gas manufacturing industry had already seen nearly half a century of progress. Gas was used for lighting purposes only and had for its competitors in this field sperm oil and candles. The oil fields in Pennsylvania had just been opened up by Col. Drake's discovery and a new rival in the lighting world was shortly to make its appearance on the scene, in the kerosene lamp. Gas was burned in open flame burners. Incandescent mantles were not thought of and the electric incandescent lamp was twenty-five years in the future. All the gas manufactured was obtained from the carbonization of coal in clay retorts. The historic Lowe Water Gas set had not been invented. With these conditions in mind we may proceed with a picture of the condensing, scrubbing and purifying practices and then trace the developments to modern equipment.

Naturally, since gas was being made for the production of light in an open flame burner, it is easy to understand the reason why air condensers were used as the first equipment for removing heat. It was thought that slow cooling of gas allowed the benzol hydrocarbons to be retained and prevented reduction of candlepower. Therefore, air condensers were very much in vogue, for primary cooling, being followed in later years by condensers of the multitubular or water tube type. Long foul mains were advocated to eliminate naphthalene, but the use of clay retorts really prevented naphthalene formation, because of the generally lower carbonizing temperature. Air condensers of various types were designed to effect the desired slow cooling. There was the horizontal type made up of cast iron pipe zig-zagging back and forth along the retort house walls. Air condensers of the vertical tube type and of the annular type were tried. A final evolution of design, before this type of condenser was discarded, resulted in a type resembling the single shell cylindrical water cooled condenser. The gas entered at the top and circulated around the baffles, and air tubes which were at least six inches in diameter. It has not been many years since this type has been abandoned in some of the older plants of moderate size along the eastern seaboard.

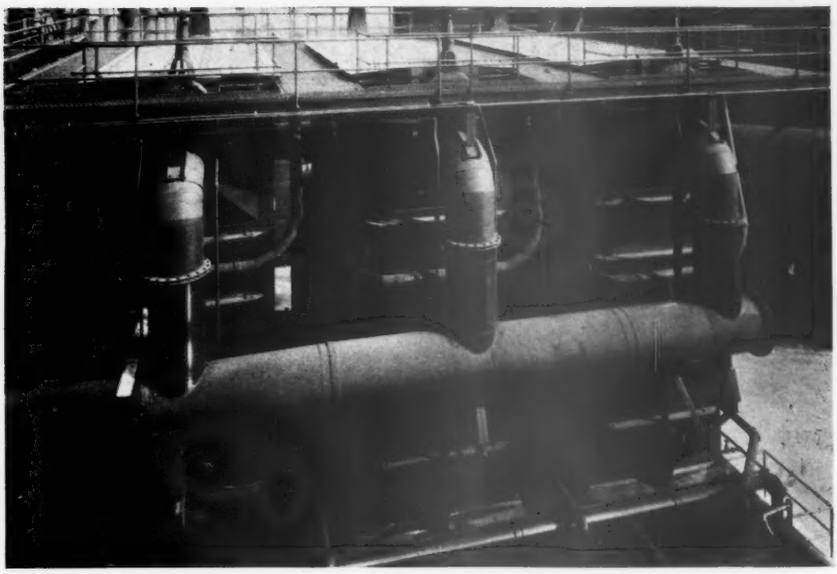
The advent of the heating standard in the decade beginning about 1910 removed all arguments for slow condensation, although water cooling had been prevalent in most plants. The design of condensers was more or less standardized by 1900 to a cylindrical vertical single pass condenser with relatively large tubes and sluggish water and gas circulation, based on the idea of slow cooling.

An early type of water cooled condenser allowed the gas to pass through the tubes and the water around them, based on the supposition that gas was dirtier than the water available. The reverse has often been found to be true and cleaning of such a type of condenser is impossible. This type requires heavier plate construction to hold water. A larger area is presented for sweating in warm, humid weather and more frequent painting is required to prevent rusting.

As been remarked, practically no condensers of this type were built in the 20th century. The water tube type with large tubes, say about 3 inches in diameter and not more than 20 feet long with open top, easily accessible for cleaning, were used. Salt water condensers with cast iron water boxes and cast iron tubes, with steel tube sheets and shells were a development which followed. It is



Two Water Tubular Condensers and Rectangular Cast Iron Condenser with 45 years continuous service, housed in building 70 years old. Tar Extractor and Feld Ammonia Washers at right.



A battery of modern high duty Tubular Condensers with eight passes and very high velocity for gas and water. Courtesy of United Engineers & Contractors.

to be noted that past practice was to house condenser equipment in buildings. Safety in modern condensing practice demands that all seals be outside of the building. The more economical practice is to dispense with the building.

Very little consideration had been given to the importance of gas and water velocity in condenser design until about 1920, at which time a very efficient high duty, multipass condenser was brought out by Haug, to combat the gaining popularity of the washer cooler.

A later development by the same company, the United Engineers and Contractors, is a salt water condenser with cast iron water boxes set in brass tube sheets. The old cast iron tubes have been eliminated, less ground space is required and construction costs lowered. These improvements in design of tubular condensers have halted what appeared to be a rather general replacement of the condenser by the washer cooler. Three important advantages of tubular condensers are lower cost for construction, less ground space and the possibility of utilization of the hot water for boiler feed purposes, or holder heating.

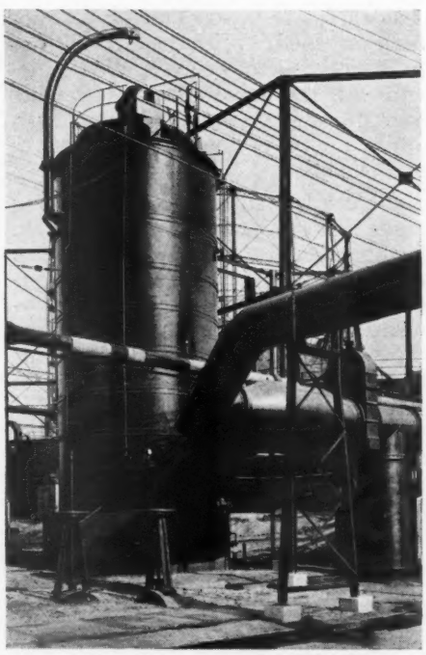
The trend away from water cooled condensers started about 1907, when the Doherty washer cooler was patented and its use soon became quite widespread, both for water gas and coal gas cooling. The washer cooler method is also favored in coke oven plants today. The principle of cooling is styled "direct," because the gas is cooled by direct contact with its own recirculated condensate, which is cooled in a bank of coils located outside of the condenser proper. In the water cooled condenser gas enters at the top and leaves at the bottom and this condensate is cooled to inlet water temperature.

In the washer, gas enters at the bottom, passes upward through a grid work, over which cooled condensate has been sprayed, which is flowing downward, cooling the gas and removing the condensate with it as it descends, which in turn helps to cool and wash the ascending hot gas. This condensate is circulated through cooling pipes which are either cooled by air or water, or a combination of both. As the method of cooling is by direct contact of gas with the cooling agent, the washer cooler serves as more than a condenser removing heat from gas. It has advantages in removing tar and sulphur impurities not possessed by the water tube condenser. The exploitation of this washer cooler was promoted by the Steere Engineering Company, now absorbed by Semet Solvay Engineering Corporation.

A valuable feature of the washer cooler is the elimination of corrosion of tubes by gas. Retubing of the usual tubular coal gas condenser is necessary at about ten year intervals. There has been very little development in the design of washer coolers of recent years. Some attempts have been made to improve the efficiency of heat transfer by use of special tubes, in the cooler, of materials such as brass, glass and special alloy steels.

Before leaving the subject of condensing it might be well to mention the development of the scrubber stand pipe in horizontal coal gas plants and coke ovens. The Congdon scrubber stand pipe was brought out about 1913 in the gas industry, although it was in use prior to that time in the coke ovens. It has been a great labor saving improvement, because stopped stand pipes have been eliminated. Ammonical liquor is sprayed into the stand pipes and collecting main in such a manner that the hot gas leaving the carbonizing chambers must pass through a film. The liquid flows down the sides of the stand pipe to the circulating main which drains into a tar decanter and, after separation from the tar, the hot liquor is pumped back to the sprays. Latent heat of evaporation plays a great part in reducing the temperature of extremely hot gases. The wash box and tar batter of the water gas set occupy a corresponding position to the scrubber stand pipe in carburetted water gas manufacture.

The exhauster is an important part of a gas purification system. Development of the exhauster has proceeded from the old two blade and three blade rotary machine to the efficient double impeller Roots type, which is very economical in steam consumption and reliable in operation. The turbo exhauster was introduced shortly after 1910 and has passed through many improvements in design and construction to the efficient and simple all steel welded modern machine. The General Electric Company was very active in this development. Turbo exhausters are more extravagant in steam consumption but this matters but little in



A Modern Feld Washer erected by the Bartlett-Hayward Co., serving as a Napthalene Scrubber.

plants having a process load utilizing exhaust steam. The turbo exhauster also has the advantage of being efficient in the separation of tar.

Treatment for tar removal is usually immediately after the exhauster. In the early days this was done by a washer in which the gas was bubbled through a strong ammonia solution. The Livisey washer involving the principles of wire drawing and bubbling was a development and was standard equipment all over the world in the early part of the present century. The advent of the washer cooler and development of the P. and A. tar extractor made its continued use unnecessary. It is thoroughly understood today that tar can not be completely removed by washing with water or liquids. Impingement of gas at high velocity on a plate surface is an improvement, but does not give complete removal of tar vapors. The P. and A. tar extractor principle is still employed, but the newer plants of moderate size use the electrical precipitation unit which gives any degree of extraction desired. P. and A. tar extractors were originally of the vertical single bell type. Koppers improved this design by using a group of bells concentrically arranged, and eventually arranged the bells horizontally and caused them to rotate automatically and be self-cleaning.

A principle of tar extraction employed by water gas plants is the shaving scrubber. It was considered a more economical procedure to allow the tar vapor to collect on plain shavings stored in a cylindrical shell with a hopper bottom, which permitted of easy dumping when the shavings were fouled with tar, rather than to allow the more valuable oxide purifying material to be spoiled.

Outside insulated cylindrical boxes built by Cruse-Kemper Co.

The last word in complete tar removal is the Cottrell electrical precipitator, which employs a pulsating high tension direct current conducted through the flow of gas, in which the separation and precipitation of electrically charged particles occur. Commercial installation of this electrical tar extractor started about 1924 and today there are approximately fifty installations in water gas plants and twenty installations in coal gas plants, detarring more than a billion feet of gas per day.

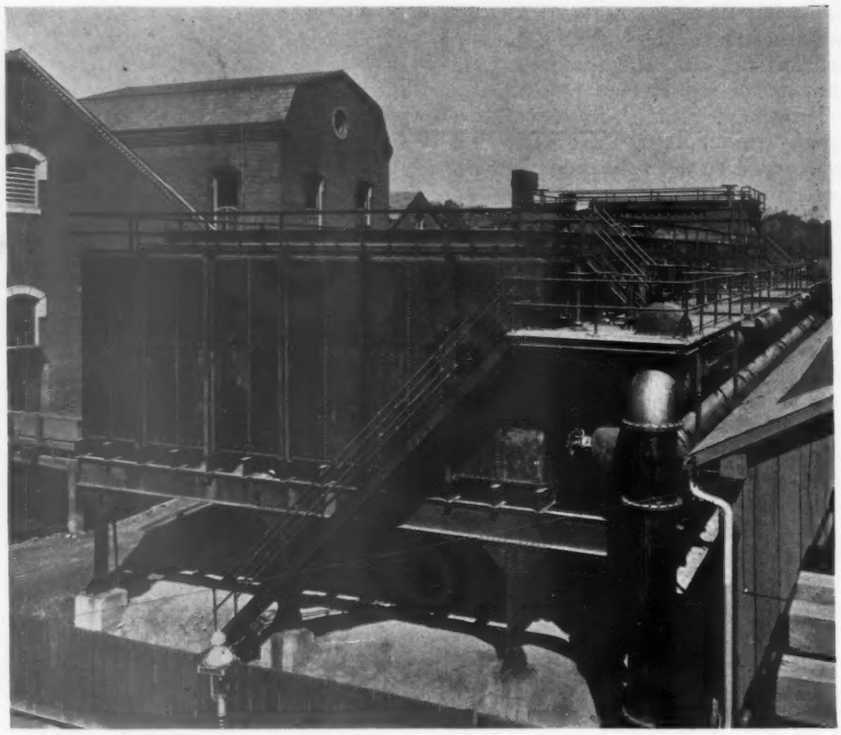
There are very few plants in this country which scrub the gas for cyanogen recovery, although some development took place during the war years. This corrosive impurity is usually retained by liquid purification scrubbers, by hydrogen sulphide removal and it is also partially absorbed by the oxide used in dry purification. It is not within the scope of this paper to consider processes, but mention should be made of the development of the Feld vertical washer, by the Bartlett-Hayward Company, which is admirably adapted to washing gases with turbid solutions, as the Ferrous sulphate of the Bueb cyanogen recovery process.

Ammonia was once a profitable source of revenue in the gas industry. Today it is only another impurity which must be removed. The affinity of ammonia for water or dilute sulphuric acid solution were the principles applied from the beginning. The tower scrubber filled with coke, excelsior or other packings over which water was uniformly distributed was the first equipment used for ammonia removal. This was soon found unsatisfactory and the wooden grid or tray scrubber was universally used. Various types of spray heads were developed to improve the scrubbing efficiency of tower scrubbers, which are greatly limited as to capacity. As early as 1880 the rotary scrubber replaced the packed tower and it in turn has been replaced by intensive grid scrubbers, which employ the principle of recirculation of the wash liquor at a high rate of flow. Only a volume equivalent to the small amount of fresh water, originally added, is allowed to overflow to the liquor wells. The rotary scrubber employs the principle of slowly rotating bundles through the scrubbing liquid and then through the gas space. Because a continuous freshly wetted surface is exposed to the gas and the counter flow principle is used, scrubbing is quite efficient in this machine. The objection to the use is complicated mechanism to construct and maintain as compared to the simplicity of intensive grid scrubbers. Two standard scrubbers erected by Isbell-Porter Company have been in use since 1886 at a plant now under the writer's supervision. Bundles, shafts and worm drive have been replaced several times and the method of driving changed from steam engine driven belts to direct connected motor, but the original sections are still in use. The Feld vertical washer has been employed by some plants for ammonia scrubbing.

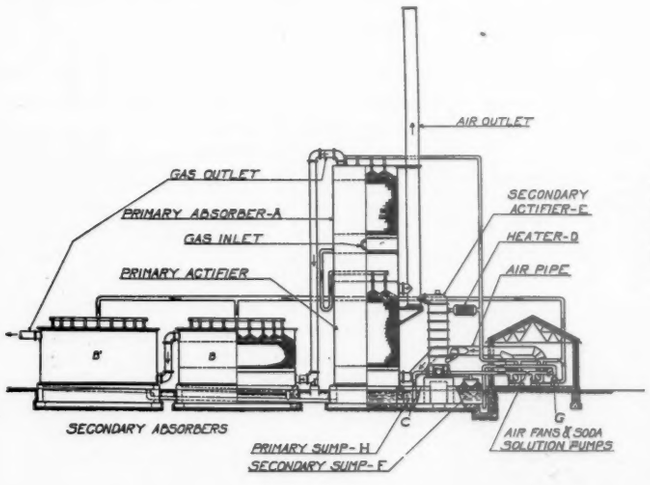
Outdoor Purifier Box erected at Havana by Semet-Solvay.

The equipment just described finds its use in indirect ammonia recovery plants. The larger plants of today generally use the direct sulphate recovery process where the ammonia is all absorbed in a saturator, which is nothing more than a lead lined bubble scrubber operating with dilute sulphuric acid as the scrubbing agent, in which ammonium sulphate salts out and is removed by an ejector, drained, washed and centrifuged. Such ammonia as is obtained from condenser or washer coolers in this type of direct plant is redistilled and the ammonia vapors returned to the gas at the inlet of the saturator. Of recent years the development of synthetic ammonia has reduced prices for sulphate and made the extraction of ammonia unprofitable.

Light oils were not removed from gas manufacture for distribution to cities until the world war, when the oils were taken out of carburetted water gas for the first time as well as from coal gas. The practice had been common in coke oven plants since the first of the century. A grid scrubber and bank of cooling coils is used similar to the washer cooler, only a paraffin oil used as the scrubbing agent and the amount of scrubbing surface is greater. Light oil removal reduces naphthalene in gas to harmless amounts. When light oils are not removed, a naphthalene scrubber is usually necessary. The latest development for this purpose is the Koppers naphthalene scrubber, as erected by the Western Gas Construction Company. It is a tall cylindrical tower divided into sections, an upper "shot" section and a lower circulating section, in which partially spent oil is recirculated over and over. This scrubber is very economical in oil consumption and efficient in naphthalene removal. When spent oil may be used for water gas manufacture and more back pressure is not objectionable, a multiple bubble. washer of the box type is satisfactory. The first cost of the latter type is much lower.



Elevated purifier box erected by Stacey Brothers Gas Construction Co.



General Arrangement of Koppers Complete Liquid Purification Plant.

A recent development to eliminate naphthalene trouble is the use of tetralin, or tetrahydro-naphthalene, sprayed into the gas. This substance has the remarkable quality of condensing out in a liquid state at the same temperature which deposits solid naphthalene and if the gas is saturated with both compounds, a sufficient amount of liquid is condensed to completely dissolve the naphthalene and prevent it from causing stoppages. The spraying or vaporizing of solvents into gas has been practiced for many years. The solvents used had a much greater vapor pressure than tetralin, which is only six times that of naphthalene for any given temperature, making the amount required to saturate the gas very much less.than is required when benzol or solvent naphthas are used.

Usually the last impurity to be removed from manufactured gas is sulphur. This is accomplished by dry purification in boxes filled with oxide of iron, or by means of one of several liquid purification systems. In the pioneer days when candlepower was desired, carbon dioxide was considered a serious impurity and lime was used as the purifying agent, because it removed the carbon dioxide as well as organic sulphur and hydrogen sulphide. There were many objections and difficulties to its usage—the objectionable odor in particular—so it was soon replaced by rusted iron borings mixed with shavings. This development occurred from 1885 to 1890. The first iron oxide used was made by mixing copperas or iron sulphate with lime. This was soon replaced by homemade oxide produced by rusting clean iron borings, using sal ammoniac and, later on, salt as an accelerator. It is quite remarkable that this process of mixing borings with shavings prevailed for about a quarter of a century.

About 1910 a new material de-

(Continued on page 151)

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Butane storage installation for meeting Peak Load conditions.

The Use of Propane and Butane by The Gas Industry

By W. Z. FRIEND,

Chief Technician, Philgas Company, Detroit, Mich.

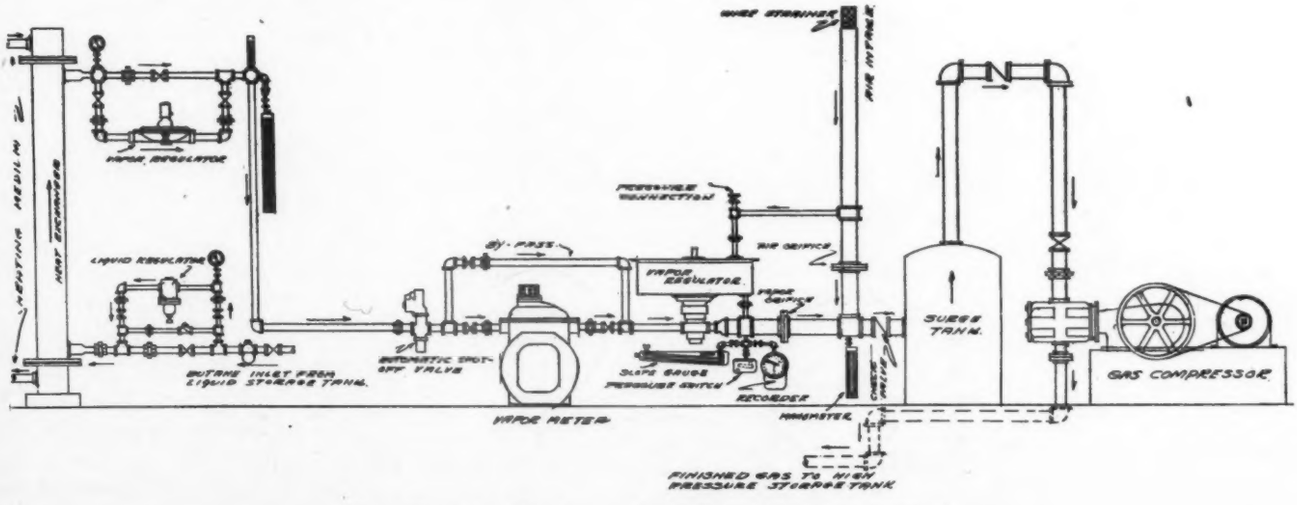
LIQUEFIED petroleum gases may be defined in a general way as those hydrocarbons or mixtures of hydrocarbons which are gases at normal temperatures and pressures, and which can be liquefied under moderate pressures at normal temperatures. Chemically, the chief constituents are propane, popylene, butane and butylene or various mixtures of two or more such hydrocarbons. Extremely small percentages of both lighter and heavier hydrocarbons may be present, depending upon the degree of fractionation.

The two principal sources of these gases are by adsorption from natural gas in the production of natural gasoline, and by absorption from refinery gases formed in the refining of crude oil. The former source has so far been the principal one but the development of refinery sources is progressing rapidly at the present time. Production from natural gas, while offering the largest potential supply, is naturally limited to those sections of the country in which natural gas is available, while production from refinery gases can be obtained on the Atlantic seaboard and along the Great Lakes as well as in the west and south. Since transportation cost is one of the principal items in the delivered cost of the commercial liquefied petroleum gases, the future development of both sources will take place simultaneously in proportion to their accessibility to the markets to be served.

Liquefied petroleum gases are usually extracted from natural gas by the oil absorption process as a part of natural gasoline. Due to improved methods in the technology of natural gasoline, it has been found desirable to market more stable grades. To do this the propane and part of the butane are removed by rectification, an art long employed in the alcohol industry. By properly controlling temperatures and pressures this process accomplishes the separation of the various components of natural gasoline and makes it possible to obtain cuts of propane, butane and heavier hydrocarbons, all of exceptional purity.

A careful survey of the potential supply shows that there are available 10 to 13 million gallons of propane and butane per day from the natural gasoline industry alone. In addition it has been estimated that about 60 major refineries east of the Rocky Mountains have a combined potential daily production of 4,800,000 gallons of propane and butane. It is very evident that these products will be available as long as we have gasoline or other liquid hydrocarbons. The problem of this industry is not one of production, but rather one of creation outlets for these materials by the development of new and existing markets.

That rapid strides have already



Flow Sheet for Constant volume Philgas Butane-Air Plant.

been made is evidenced by the production figures for the past few years:

Year	Marketed Production Liquefied Petroleum Gases Gallons Per Year (a)	Percent Increase over Previous Year
1922	222,641	....
1923	276,863	24.4
1924	376,488	36.0
1925	403,673	7.2
1926	465,085	15.2
1927	1,091,005	134.6
1928	4,522,899	314.6
1929	9,930,964	119.6
1930	18,017,347	81.4
1931	28,769,576	59.7
1932	33,630,236	16.9
1933 (b)	39,000,000	16.0

(a) From U. S. Department of Commerce Report of March 16, 1933.
(b) Estimated.

Properties of Liquefied Petroleum Gases

Rapid and accurate methods of low temperature fractional analysis have been developed so that it is possible accurately to determine the properties of these products.

By careful control of the manufacturing process, by laboratory tests and checks, and by strict adherence to rigid specifications, products of unusual uniformity are obtained. Table I gives a brief resumé of average characteristic properties of commercial propane and butane.

Table I—Properties of Butane & Propane

	Com. Propane	Com. Butane
Vapor pressure, lbs. per sq. in. gage at 70° F.	125	26
Vapor pressure, lbs. per sq. in. gage at 105° F.	208	57
Dew Point at 14.7 lbs. per sq. in. Abs., ° F.....	—47	24
Sp. gr. of liquid (water = 1) ..	0.5105	0.582
Initial b.p., ° F..	—45	15
Weight per gal. of liquid in lbs.	4.25	4.84
Cu. ft. per gal...	36.5	31.5
Sp. gr. of gas (air = 1).....	1.52	2.01
Limits of inflammability:		
Gas % in gas-air mixture for upper explosive limit	9.6	8.6
Gas % in gas-air mixture for lower explosive limit	2.5	1.9
Maximum rate of flame propagation, cm. per sec. in 2.5 cm. diam. tube..	86.7	87.1
Heating Value:		
B.t.u. per cu. ft.	2,500	3,240
B.t.u. per gal.	90,680	102,000
Latent heat of vaporization at b.p., B.t.u. per gal.....	793	808

Intermediate grades can be readily prepared by blending these basic grades.

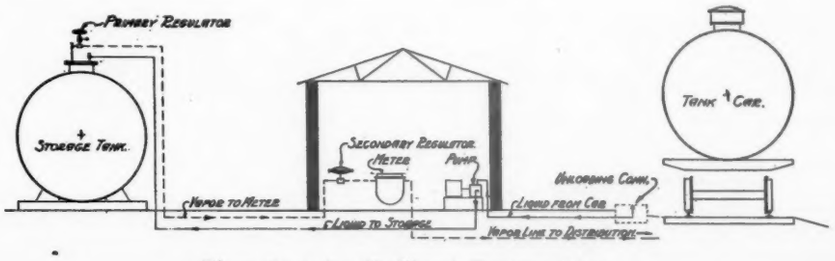
Field of Utilization in the Gas Industry

Having a common source, liquefied petroleum gas and natural gas have common characteristics, the chief difference being their physical state. This similarity of properties makes the use of propane and butane, within the gas industry, of wide application. This field of utilization can be classified as follows:

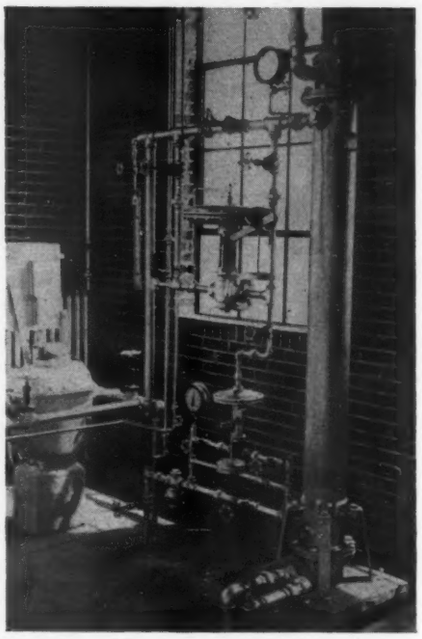
(1) Direct Gas Service to towns and communities too small and at too great a distance from main transportation lines to warrant the installation of transmission lines.
(2) Meeting peak loads.
(3) For standby purposes.

Direct Gas Service by Means of Central Plant Distribution

A recent survey of towns without gas shows that there are nearly 2000 communities between 1000 and 2500 population, and approximately 400 over 2500 without gas service. The total gas required for any of these communities is small. The load factor is very apt to be extremely low, hence supplying these towns with gas through transmission lines economically is often quite out of the question inasmuch as the fixed charges would be prohibitive. Liquefied petroleum gases in many instances furnish the solution to this problem today. There are some 143 towns receiving gas service in this manner, which are furnished in either of two ways, (1) by Butane-air plants, or (2) by distributing undiluted propane or propane-butane vapors through pipe lines.



Flow sheet for Undiluted Propane Plant.



Typical vaporizing apparatus.

The first butane-air plant was installed at Linton, Indiana, in June, 1928, this community previously having been served with coal gas. The operation of the Linton plant was closely followed by gas engineers and in February, 1929, the second plant was installed at Sheridan, Indiana. During the summer of 1929 three additional installations were made. Up to this time all of the installations were conversion jobs in which butane gas replaced coal gas, carburetted water gas or natural gas. The possibilities of this new process were more fully recognized by the gas industry and in the Fall of 1929 construction was started on installations at Harrisonburg, Va., Cleveland, Tenn., and North Manchester, Indiana—towns that had not previously enjoyed gas service. From that date on, the development was more rapid, and during 1930, the peak year to date, fifty-six plants were installed. Increase since then has been somewhat slower due to the industry's lack of available capital for plant investment.

The process of manufacture is very simple and consists essentially in carburetting a non-condensable gas with a high calorific liquefied gas to produce a mixed gas of the desired calorific value which is distributed in the conventional manner through mains. Flue gases, exhaust gases or air can be used as the diluent. As air is the more readily accessible and since it does not require any processing to remove undesirable constituents, it is generally employed.

When using air and butane or propane (all having constant physical

and thermal properties), the problem of obtaining a constant calorific value gas is reduced to maintaining a constant ratio between the two, the calorific value of the mixed gas being a direct function of percentage of butane or propane vapor present.

There are a number of methods of mixing and proportioning the two gases, among which may be mentioned:

Positive proportioning device employing variable orifices with fixed differential.
Fixed orifices and fixed differential.
Fixed orifices with varying differential.
Calorimetric devices where the ratio between butane vapor and air is maintained by electrical and mechanical controls actuated by Calorimetric means.
Metered liquid injection.
Venturis or inspirators.

The finished gas is generally compressed into a gas storage tank and distributed at semi-high pressures. The cost of plant equipment is low, so that fixed charges are not excessive. This, together with low fuel, power, and labor costs, make this process well adapted for installations having a potential of at least 350 customers. However, the cost of plant equipment is not directly proportional to the plant capacity and there is therefore a minimum investment which cannot be lowered, even with fewer customers and a smaller distribution system.

Distribution of Undiluted Liquefied Petroleum Gas Vapors

As indicated above, there are certain conditions where the installation of a propane-air or butane-air plant would not warrant the plant investment. The problem then becomes that of the elimination of as much of the plant equipment as possible. Instead of distributing a mixed gas it is possible to distribute the vapor undiluted and, in this manner, do away with the necessity of carburetting and compressing equipment, as well as finished gas storage. Since the increasing use of the undiluted vapors is one of the most important developments in the use of these fuels in the gas industry, a little study of the methods used will be of interest. It would not be feasible to distribute undiluted butane vapor, due to the fact that the dew point of 100% butane vapor is 24° F. at atmospheric pressure, which would result in condensation of liquid at temperatures below this point. In the case of butane-air gas where the butane fraction is only some 16 to 17%, the dew point of the mixture is decreased in accordance with the law of partial pressures, so that no difficulty is experienced even at low temperatures and high pressures. Hence, for undiluted vapor distribution, instead of using butane, propane having a dew point of —47° F. is recommended.

In some instances a mixture of propane and butane is used. This is satisfactory under certain climatic conditions, although it necessitates employing flash vaporization. Vapors drawn directly from liquid storage tank containing such a mixture produce a batch distillation effect resulting in a fluctuating calorific value.

Propane being self vaporizing at all temperatures above —47° F., obviates the necessity of a vaporizer, so that the plant equipment is reduced to a liquid storage tank, regulators and station meter. The propane vapor is withdrawn from the top of the storage tank.

The pressure is reduced in two stages, first, by means of a ratio type regulator located on the vapor line at the liquid storage tank which maintains a reduced pressure proportional to the tank pressure. This prevents the possibility of any liquid condensation in the vapor line leading from the tank to the regulator and meter house. The final regulation of the pressure carried on the distribution system is obtained by a conventional type regulator. The gas is metered on the down stream side of the regulator before entering distribution mains, which usually operate at from one to five pounds, with individual house governors ahead of the customers' meters.

In designing a distribution system for serving a town with undiluted propane vapor, two important considerations must be kept in mind:

(a) Thermal value of the gas, and
(b) Possibility of another gas being distributed at a later date.

Undiluted propane vapor has a thermal value of approximately 2500 B.t.u. per cubic foot and due to this high heating value the volume of gas used per consumer is only about one-fifth that of standard 530 B.t.u. manufactured gas. The pipe lines can therefore be greatly reduced in size, making possible a reduction in the capital investment required for the distribution system. In event that the undiluted propane plant is installed pending the extension of transmission lines of either natural or manufactured gas, or to provide gas service until such a time as a butane-air gas plant or gas manufacturing plant is economically justified, the distribution system must of course be designed to handle the fuel that is ultimately to be provided.

The mains need not be laid to grade and no drips are required as propane vapor contains no moisture, hence at prevailing ground temperatures under the pressures employed there would be no liquefaction. The mains need not be laid below frost line, as 24" coverage is sufficient to prevent mechanical damage, except at street crossings, where greater depths are advisable.

Due to the high calorific value of propane, meters capable of accurately measuring these small volumes are required. Several meter manufacturers have developed meters that are sufficiently accurate and dependable for this service. The meters must, of course, be equipped with diaphragms suitable for the handling of undiluted propane vapors.

Adjustments for Metering

In connection with the metering of this gas the question arises as to the most desirable basis of billing the consumer for the volume used. If the gas were billed in terms of cubic feet of 2500 B.t.u. gas, upon first examination of the rate, it would appear prohibitive and would require considerable explanation. It is easily possible to change the gear ratio of the meter index so that the volume passed is automatically registered in terms of a commonly accepted standard of heating value, such as 530 B.t.u. per cu. ft., or a therm basis, and rates on these bases are readily comparable with those of other cities.

Railroad Siding.—The plant site must be so situated that a railroad siding can easily be built for delivery of tank cars. This siding should be located so that point of unloading is at a distance of at least 75 feet from any track over which a passenger train travels, in order to comply with American Railway Association regulations.

Plant Building.—The plant equipment can be housed in a simple building of approximately 8′ x 12′ floor space. The building may be constructed of any of a number of building materials but should be substantial and present a permanent appearance.

Plant Equipment.—The equipment consists essentially of a 15,000-gallon storage tank, pressure-reducing regulators, compressor or liquid pump for tank car unloading and station meter. At plants where bottled gas service is to be provided to nearby communities, a pump is required for filling the cylinders and tank trucks, and the same pump can also be used for unloading the tank cars.

The chief advantages of this type of distribution are:

(1) Low investment with attendant reduction of fixed charges.

(2) Low maintenance costs.
(3) Reduction of plant and distribution labor costs to a minimum.
(4) Due to high vapor pressure of propane, it is not necessary to compress gas for semi-high or high pressure distribution, hence elimination of compression power costs.

All of these advantages make this type of distribution especially adapted for towns where the total volume of gas consumed is such that the installation of a butane dilution plant would not be economically warranted. In addition, the flexibility of distribution which renders it possible to serve outlying territory by means of "bottled gas" systems or tank trucks, is an important factor in deciding whether it is more feasible to consider the installation of high pressure transmission lines, a butane or propane dilution plant or an undiluted vapor distribution system.

Several undiluted vapor plants have been installed during the past few years. In one area in Minnesota, some 22 communities are served with bottled gas by means of tank truck from the same plant which serves the central plant through pipe lines.

The Use of Liquefied Petroleum Gases for Meeting Peak Loads

The problem of meeting peak load demands is one of serious importance to the gas industry. The low cost of liquefied petroleum gas storage, handling, and utilization equipment results in a low investment cost, with attendant low fixed charges and maintenance. In addition, the flexibility of the fuel and range of control are added characteristics that make these products valuable means of meeting peak loads with both manufactured and natural gas.

Space does not permit giving a complete discussion of this subject, which will here be confined to outlining briefly some of the many methods whereby increased capacity to meet peak loads can be obtained.

1. Manufactured Gas.—(a) The use of propane. Where the amount of peak gas required is small, propane has been used for meeting temporary peaks. The low cost of equipment required makes this method especially applicable.

(b) The use of butane-air or propane-air gas. When the volume is larger, it is undoubtedly more economical to use butane-air or propane-air gas. The allowable volume increase is greater. A butane-air installation made at San Diego, California, increases the daily capacity of the oil gas generating equipment from 20,000,000 to 27,000,000, or an increase of 35%, the total cost being approximately 25% of the estimated cost of oil gas equipment of similar capacity.

2. Natural Gas.—(a) Mixing Undiluted Butane or Propane Natural Gas. It is possible by the addition of undiluted butane vapor to increase the volume of natural gas (.65 sp.gr. —1100 B.t.u.) approximately 11 per cent and still be within the 20 per cent allowable gravity increase. Due to the fact that this mixed gas would have a calorific value of approximately 1300 B.t.u., the total thermal increase would in reality be over 30 per cent. When the total peak gas required is small, this method can be used. The investment in equipment is minimum, although the fuel cost of the gas due to its increased thermal value would be high.

(b) Mixing a Butane-Air or Propane-Air Mixture and Natural Gas. When the peak volume is of any magnitude, it is more feasible to employ a liquefied gas-air mixture of 1100 B.t.u. Such a gas would require 10.72 gallons of butane per M cu. ft. With such a mixture it would be possible to increase the volume 30 per cent. The fuel cost per M would be considerably less than when employing the undiluted butane vapor.

In the event a percentage greater than 30 per cent were required, it would be necessary to increase the thermal value of the butane-air mixture. Calculations show that a mixture of butane and air of higher calorific value would be interchangeable with natural gas in all proportions as far as appliance adjustments are concerned, thus providing a means of supplying gas service in an emergency.

Various tried and proved equipment for mixing, proportioning and controlling these gases are available to the industry at a moderate cost.

(c) Mixing Manufactured Gas and Butane or Propane. It is possible to enrich coke oven gas or carburetted water gas with butane or propane as a substitute for natural gas. The Illinois Power and Light Company were distributing natural gas to certain towns in southern Illinois. In the Autumn of 1931, the supply of natural gas decreased to such an extent that it appeared doubtful if a sufficient supply to carry the Winter load could be obtained. A high pressure transmission line, carrying 570 B.t.u. coke oven gas, supplying some nearby towns, ran through one of these natural gas towns. To change from natural gas to coke oven would have meant lowering the calorific standard as well as making necessary adjustments on appliances. To employ a mixture of natural and coke oven gas would also result in a decreased thermal value and, as the supply of natural was uncertain, it might have proved difficult to have maintained a constant mixture. For this reason it was decided to enrich the coke oven gas with butane to produce a gas of the same calorific value as the natural gas. The specific gravity of this mixed gas is almost identical with that of the former gas so that no appliance adjustments are necessary, and the butane enriched coke oven gas has now been substituted 100%. The producing wells are shut down during the day and the entire load carried on the enriched gas; during the night natural gas is used. The results obtained have been very satisfactory. Automatic proportioning by means of a pressure differential regulator and orifice reduces operating cost to a minimum. The cost of plant investment was very low, so that the total cost of this peak gas is very reasonable.

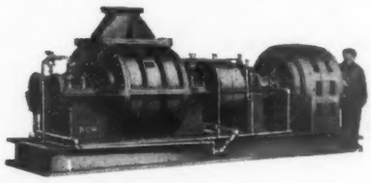
Louisville Experience

Louisville, Ky., has for several years employed mixed gas. During the Summer months, straight natural gas of 1150 B.t.u. is distributed. Due to the large amount of house heating, the Winter requirements are nearly four times the normal Summer load and the amount of natural gas available is insufficient. Water gas is used to give the additional volume, the calorific value of the mixed gas being 850 B.t.u. The water gas generators were unable to furnish sufficient gas to meet extreme peak conditions and at the same time meet the 850 calorific standard; the volume of 550 B.t.u. gas required being such that when mixed with the 1150 B.t.u. natural, the mixed gas would fall below the required minimum. Rather than provide additional generator capacity, it was decided to employ butane. Storage for 150,000 gallons was installed, together with the necessary handling equipment. The increased capacity required was obtained by increasing the amount of blow run, oil being used on the back run and recarburetting this gas with butane to such a calorific value that when mixed with natural gas, the resultant gas would still be over the 850 B.t.u. minimum. In this connection it is interesting to know that by means of butane it has been possible to produce a carburetted water gas of 850 B.t.u. to take care of an emergency load caused by a break in the natural gas transmission line.

(Continued on page 97)

ROOTS-CONNERSVILLE EQUIPMENT Has Progressed Through 75 Years of SERVICE to The GAS INDUSTRY

Roots page, published in 1909, celebrating 50th Anniversary.



Gas Pumps are constructed in sizes ranging from 5 to 50,000 cu. ft. per minute at pressures up to 12 lbs., in the standard type, and up to 30 lbs. in the compound arrangement. Cut shows a large compressor.

Connersville Meters have capacity range of 1000 to 1,000,000 CFH in single units. Suitable for high and low pressure lines. Low-pressure types range up to 25 lbs.; other types up to 75 lbs., and higher.

CLOSELY paralleling the growth of the Gas Industry, Roots-Connersville equipment has been the accepted standard of performance for upwards of 75 years. Constant improvement and refinement, to meet changing conditions, have kept these products abreast of the times. Their reputation has been built on dependability.

After the Rotary Positive Blower had been pioneered, other types of equipment, built on the same sound principle, logically followed; including Gas Boosters and Exhausters, Cycloidal Liquid and Vacuum Pumps, and Positive Displacement Meters. Today, Roots-Connersville is building many important items used in producing and distributing manufactured and natural gas.

In addition to the products listed above, R-C Harrison Purging Machines, Centrifugal Compressors and Exhausters, and Turbine Pumps are available.

Long experience in specializing in equipment for the economical handling of air, gas, and liquids assures units offering maximum service and reliability with minimum operating and maintenance expense. Our sales engineers will welcome an opportunity to discuss your requirements. Estimates furnished without obligation.

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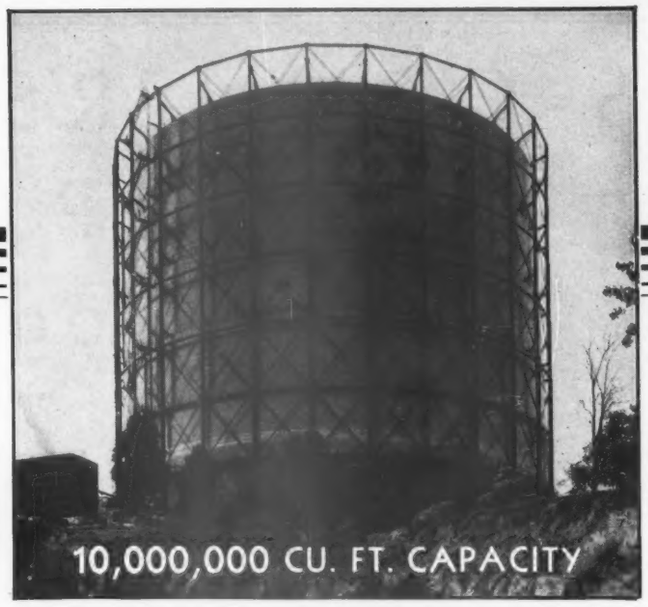

GAS HOLDERS

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•

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Gas Tanks Now and Then

By
HERBERT W. ALRICH

Engineering Dept., Consolidated Gas Co. of New York

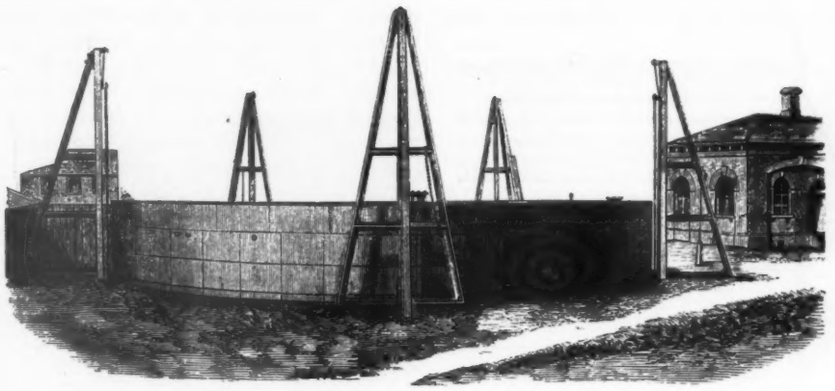


Fig. 1—Fulham Gas Holder, built in London in 1859

WHEN Editor Riley called upon me to write this article, I had to confess to him that I have wrecked and removed from the landscape more gas holders than have been built in the entire City of New York during my career in the Gas Industry. Now while many esthetic persons will regard me as a benefactor and propose honoring me with a monument erected in some public place, this record is a drawback to my rating as a constructive engineer, and those who know about this call me a humbug. I doubt that I shall ever be able to live my record down.

However, Editor Riley was determined that I should write something and so we had to find some way for me to "make the grade," and to do that we have agreed on the story that Riley, Alrich and the *Gas Journal* all started in the business in 1859. While this is not by any means true, it makes a good story and, whether you believe it or not, we shall stick to it. So here we go—Riley, Alrich and the *Gas Journal* all starting in the Gas Industry in the year of Our Lord 1859.

To get started right with this story, it is important to make clear just what kind of gas holders or gas tanks we are talking about. The *New York Times* found it necessary, as far back as April 7th, 1872, to clear this matter up. It stated,—"It does not necessarily follow that where there is the most gas, there must also exist the greatest quantity of light; and it is to be regretted that statistics show so large a proportion of instances where gas holders, inexhaustible in their respective capacities, afford an article that possesses the very reverse of illuminating qualities. These latter are peripatetic gas holders, generous in their effusions, but as mystifying in their effects as a London fog. Congress, Legislatures, the hustings, and even Courts of Justice, are sadly plagued with them." But the gas tanks or gas holders I shall here discuss are an assemblage of ferrous plates and bars and rods and are more than a mere degenerate growth of flesh and bone.

Just how Riley got started in the Gas Business I do not know—he may not even be willing to tell. My intrusion into the Industry was the result of contamination during childhood. At that time I lived in the outskirts of Wilmington, Delaware, in the neighborhood of an isolated holder of the local gas company. It was a huge structure having a capacity of fully 250,000 cu. ft.! It had two lifts in a masonry tank and to my juvenile mind it was a mysterious and wonderful mechanism. I spent many hours and days sitting on a piece of cast iron pipe embowered in a profusion of rank, smelly weeds, watching those two sections cup and uncup. I finally got its movements so perfectly scheduled that I could tell by the clock when the outer section was due to go up or come down and would bolt out of the house while my mother frantically screamed, "Keep away from that old gas tank or you will fall in and get drowned." While there are conflicting reports about this, I shall here deny any fatal outcome.

Just how many gas holders there were in the United States at that time is not a matter of record, but I glean from my studies that the total capacity of all of those in the United States was about fifteen million cu. ft., of which about four million cu. ft. was in the City of Philadelphia, and another four million cu. ft. in the old City of New York.

The familiar type, the water sealed holder, consists of an inverted container floating in a tank of water. In its essential features it was invented by the eminent French Chemist, La-

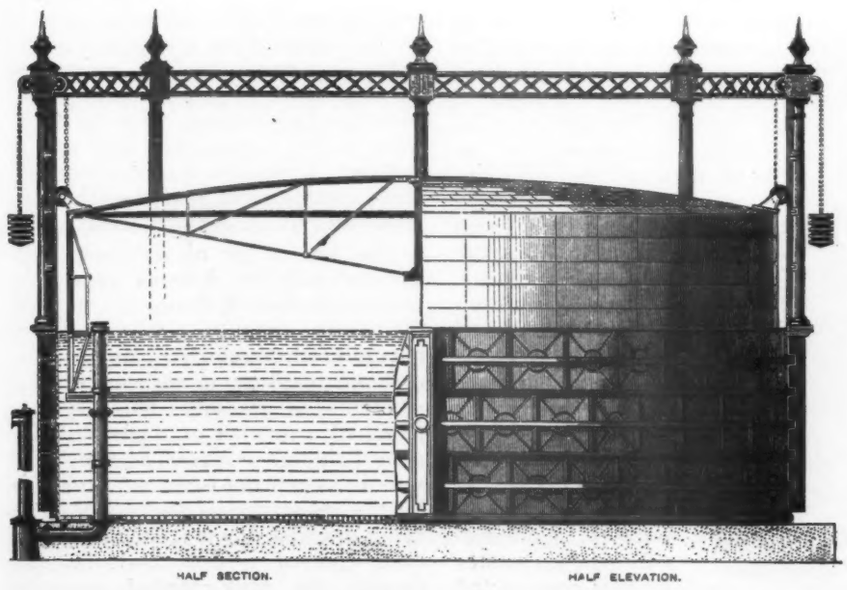


Fig. 2—English Holder Constructed of Ribber C. I. Plates

voisier, some ten years before William Murdock began the historic experiments which resulted in the founding of our great industry which has yielded so much of comfort and convenience to mankind. As far as we know, Lavoisier's gas holder consisted of an ordinary cylindrical bucket inverted in a small tub of water. The bucket was suspended from a cord attached to the center of its bottom, the cord passing upward and over a pulley with a small weight attached to the other end. It is believed that Murdock's first gas holders were of exactly the same design, though as his requirements increased, he obtained greater capacity by using a wooden vat for a tank, with a sheet iron container as before These early gas holders of Murdock's and of his successors seem to have consisted, like their prototype, of merely a water tank and a suspended container. It was not until 1829 that a gas holder was built in England having the rudiments of a guide frame. As this holder was still in service at the Fulham Station in London in 1859, when Riley, Alrich and the *Gas Journal* entered the Industry, it is proper to describe it here. King, Vol. II, p. 117. It was 50 ft. in diameter by 18 ft. deep and had a capacity of about 35,000 cu. ft. At the time of its construction it rated as a large gas holder and was regarded as a daring adventure. It marked a distinct advance in construction and pointed the way for the building of holders in larger sizes than had previously been attempted. The succeeding years witnessed a furious activity in the construction of gas holders throughout Europe, the Continent and America, with the English designers in the forefront.

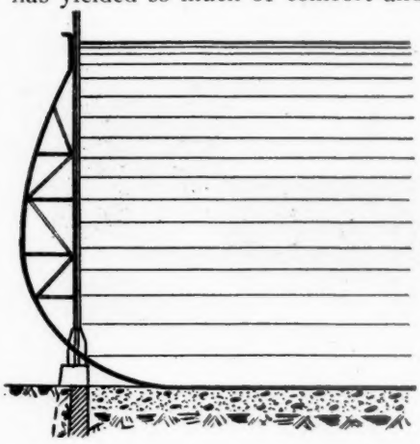


Fig. 3—Bonnet Design to Avoid Heavy Construction.

The water sealed gas holder presented to these pioneers problems of design for the tanks, for the lifts or sections and the guide frames. Of these three essential parts of a water sealed gas holder, the lifts quickly arrived at a rather satisfactory and standardized design, but the tanks and guide frames were to pass, through much experimentation and many phases of development before there would be obtained among builders a somewhat common thought as to which designs and types were the most advantageous.

When Riley, Alrich and the *Gas Journal* started in the Gas Business in 1859 (I keep saying this over again in the hope that somebody may believe it, even though it is not true), many holder tanks had been built in England of large diameter, one of which at the Hackney Road Station in London was about 203 ft. in diameter and about 40 feet deep. The designers and builders of these tanks were master masons of great skill, but the fact still remains that they had scant knowledge of the mechanics of materials and were unfamiliar with the science of earth pressures as propounded by Prof. Rankine, Sir Benjamin Baker and Dr. Terzaghi. Some times they squandered money by distributing their structural materials in such a manner as to serve no useful purpose. Undoubtedly these master masons constructed many successful tanks of large diameter, but this was because practical experience and excellent workmanship outweighed their lack of technology. The designing of such structures in conformity to the principles of modern engineering awaited the advent of reinforced concrete construction some 35 years ago.

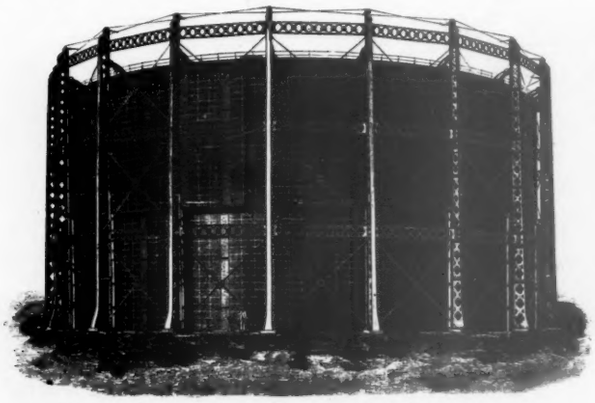


Fig. 4—Livesey Holder; Capacity 2,000 M cu.ft.

But for a decade beyond that in the designing of brick tanks, there was applied the analysis originated by M. Arson, a French Engineer. It would be more accurate to say that the designer made calculations employing Arson's formulae, for if he had applied the mathematical results of Arson's method, carried to its logical conclusion, there would have resulted walls of twice the thickness at the top as they had at the bottom. From this we may conclude that common sense spared us the consequences of M. Arson's theory.

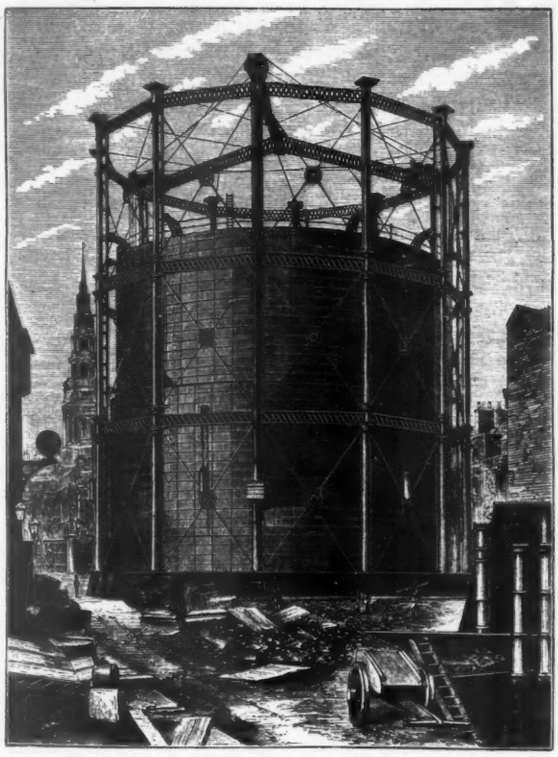


Fig. 5—Mann Three Lift Holder Built in 1861.

The knowledge of the mechanics of materials in Arson's time was somewhat limited, hence his method disregards entirely the elastic behavior of the material. By his theory the pressure is resisted by the moments of stability, taken collectively of a number of segmental elements, similar to staves, of which the wall is assumed to consist, and also by the resistance of the masonry to being cracked down from the top at each end of a diametral line, as though the tank tended to split through the center, and each half

Fig. 6—Holyoke Gas Works; Holder Housing on Left.

overturn.

To accept this reasoning would require us to assume that the circumferential stretching of the masonry wall under hydrostatic pressure is necessarily accompanied by each stave-like element leaning outward about the toe of the base. As this form of resistance cannot be effective until the wall has actually resolved itself into these assumed vertical elements, that is, cracked from the ring tension, the fallacy of this method of computation is apparent. In a contribution to the American Gas Institute, Volume 5, Pages 570-591, I discussed this subject at some length and pointed out that a brick tank of large size requires external assistance, for any such thickness of masonry as would safely withstand the pressure unaided is economically impossible.

The important consideration in the construction of holder tanks in the earlier years of our Industry was the necessity for water tightness; not only did foul water leaking from the tanks contaminate the water in wells upon which even populous communities relied for their supplies, but the holders being frequently located closely adjacent to dwellings, the buildings were rendered uninhabitable by the foul water entering through cellars. Much of the soil formation in England being of clay was favorable to the construction of water tight masonry tanks. When these same designs were applied to American conditions, the results were frequently very unsatisfactory and the leakage was so great that it was often necessary to reconstruct the tanks.

With soil conditions unfavorable to the construction of masonry tanks, it is not strange that the American engineers quickly took advantage of iron plates, when such were produced of sufficient size and thickness, and began the construction of metal tanks. However, at the same time the rolling mills were producing larger iron plates, their progress was outstripped by the increase in the size of gas holders which the Industry required. From the information available, it would appear that the first iron holder tank in the United States was built by the Bartlett Hayward Company in 1876, but all metal holder tanks were necessarily restricted to small diameters until American industry developed not only the production of steel plates of sufficient size and thickness, but also the craftsmanship and technology required for the compound rivetted joints necessary to the massive construction involved in the building of a large diameter tank.

In 1859 there were in England a number of holder tanks constructed of ribbed cast iron plates. Many others of this type were built later, including one about 150 ft. in diameter for a three lift holder in Brussels, which is still in service.

The first steel holder tank of considerable size was designed and built for the Consolidated Gas Company of New York by the Continental Iron Works of Brooklyn in 1888. The proprietors of this establishment were Thomas Rowland and his sons. These men, with their associates, for many years occupied a prominent place in the technical advancement of fabrication of iron and steel. The tank is 193 feet 2 inches in diameter by 41 feet 9 inches deep. As steel plates of suitable quality and of the required thickness were not available, the builders resorted to double thickness plates for the lower five courses of the tank shell. I have had the opportunity of reviewing the studies for the compound rivetted joints required for this tank and was surprised to discover the thoroughness with which the problem had been analyzed by the designers. Their computation for these rivetted joints could be used today for the instruction of engineering students. The next steel tank of large size was one built in New York for the Standard Gas Light Company in 1892 for a three lift holder of two million cu. ft. capacity. The tank was 162 feet, 6 inches in diameter and 134 feet deep. In 1893, the Continental Iron Works built a second three million cu ft. holder for the Consolidated Gas Company, this tank being 180 feet in diameter. Though many holders were constructed throughout the United States and Canada in the decade after the appearance of this first large steel tank, the evident preference was for brick tanks and steel tanks did not become the common practice until about 1901. The machinery, equipment and methods for

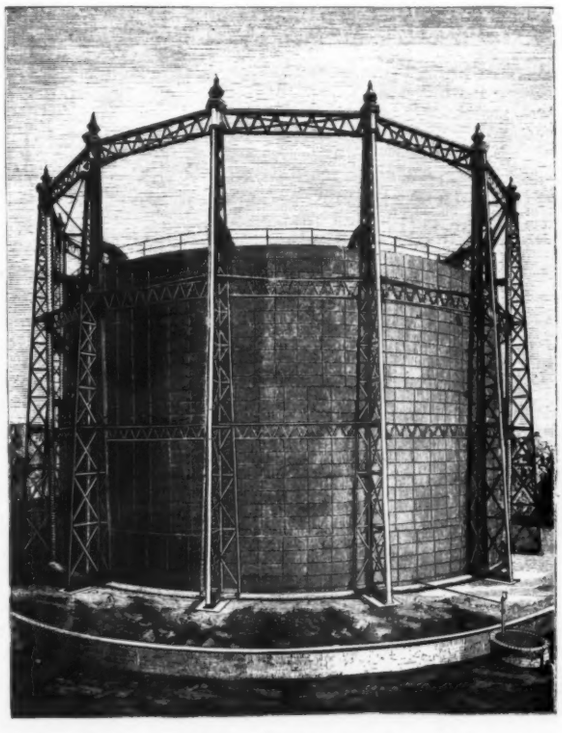


Fig. 7—Brighton Holder, built in 1876.

the fabrication and erection of steel tanks eventually reduced their cost far below that of masonry tanks, the cost of which was constantly rising through the reduction of hours and increase of wages of the bricklayers. Since the advent of the steel tank, some masonry tanks of large size have been constructed to meet special conditions and circumstances.

Bonnet's Design

About 1910, a French Engineer, M. Edouard Bonnet, devised a new type of steel tank in an effort to avoid the massive construction required for cylindrical tanks of large diameter. As will be seen from Fig. 3, the profile of the tank on a radial line is an equilibrium curve known as the hydrostatic chord. The tension at any point in the walls of any vessel having a curved perimeter under fluid pressure in equilibrium is equal to the product of the unit pressure and the radius of curvature. Hence, as the internal pressure is met by the tensional resistance in a meridional plane without developing any serious circumferential tension, it is evident that this design permits the plating to be very thin. To make the nearest approach to the ideal stress conditions requires that the shell of this tank be uniform, elastic and unrestrained. This as a practical matter proved to be a very difficult undertaking. While a few of these tanks of large size were built on the European Continent, the impracticability soon became apparent and the method was abandoned.

The largest steel holder tanks in the world are those for a ten million cu. ft. holder in Chicago, and one of the same size in Brooklyn, each of which are 271 ft. in diameter. The two reinforced concrete tanks for the two fifteen million cu. ft. holders at Astoria are the largest masonry tanks in the world, though at this date another tank of the same diameter, but of lesser depth, is under construction for a ten million cu. ft. holder at Washington, D. C.

In 1859, the majority of gas holders in the world consisted of but two lifts and were infrequently of more than 300,000 cu. ft. capacity. Sufficient guide framing for these holders was provided by spacing a number of posts or columns around the top of the tank coping. These columns were made either of cast or wrought iron. As the structures increased in size and became more prominent, the designs for these guide frames were made by architects, who preferred cast iron construction because it permitted the execution of ornamental columns or uprights conforming to the classical orders. Some times the columns were round and decorated with fluting, each having an ornamental base and capital. Other designs had rectangular cast iron uprights decorated with Italian scrollwork or Gothic carving. The struts that connected the tops of the column, when made of cast iron, were likewise elaborated with fleur-de-lis or other ornamentations. Many holders were beautified with cast iron urns placed on top of the columns, from which growing vines festooned downward upon the structure.

But as the size of the holders increased, the classical designs of guide framing became less frequent, doubtless for the reason that, with the larger holders, cast iron was not the suitable material for constructing the guide frames required to resist the thrust imposed by a high wind blowing upon the large area of the inflated holder. Thus the architect as a designer of guide frames yielded his place to the pioneer structural engineer. While we may now regard as primitive the structural engineering of the 70's, we must commend the understanding those engineers displayed in the design of their guide frames which indicated both ingenuity and a proper disposition of the metal. Figure 4 illustrates a two million cu. ft. holder built in the 70's for the South Metropolitan Gas Company of London, which is evidence of the skill of its designer, Mr. G. T. Livesey.

American Holder Frames

The design and construction of gas holder guide frames in America continued to reflect a great variety of ideas and much individualism, until the steel industry in America began producing standardized shapes for structural steel. As this occurred at the same time as the development of the manufacture of the large steel plates required for the holder tanks, in the early 90's, the standardization of holder designs was the immediate result. Each contractor specializing in gas holder construction worked out a design and, figuratively, made up skeleton sheets and filled in the figures for the different size holders.

In 1888, a well known English Engineer, Mr. W. Gadd, devised the spiral guided gas holder, of which a number have been built and are still being constructed in England. However, as far as I know, but two have been erected in the Western Hemisphere, one of five million cu. ft. capacity in Montreal, Canada, and another in Buenos Aires in the Argentine Republic.

Owing to the inclement weather prevailing in some parts of North America, it became a frequent practice to enclose gas holders with brick buildings, but with the great increase in the size this became expensive and inconvenient, and also represented a serious hazard in case of the escape of gas. While this practice was abandoned in America during the 80's, several holders of large size thus enclosed were erected (later than 1900) in Berlin and Vienna, where the important consideration was architectural appearance. Fig. 6, showing a holder housing at Holyoke, illustrates the typical construction of such buildings in the 50's.

Advent of Multiple Lift

During the early decades of the Industry, single lift holders met all requirements, but when capacities beyond a few hundred thousand cubic feet were needed, some unknown genius invented the multiple lift holder. This permitted the construction of two lift holders up to capacities of about two million cu. ft. The first attempt at a three lift holder, in London in 1852, arose from the difficulties of the site, as the tank of this holder was 108 feet in diameter and 12 feet 6 inches deep, the lifts were too shallow for satisfactory operation and the holder was not a success.

The next and first successful attempt at building a three lift holder was in London in 1861. It had a cast iron tank 84 feet in diameter and 33 feet deep, depressed into the ground for most of its depth. This holder is illustrated in Fig. 5, and the guide frame evidences the thorough study given to the problem by its designer, Mr. William Mann. The next three lift holder was erected in Brighton in 1876 and is illustrated by Fig. 7. It will be noted that the guide frame shows a great advance in structural design.

It would require much research to trace the construction of the first gas holder having more than three lifts, but in 1891 an eight million cu. ft. holder having four lifts was erected at the Beckton Station, London, and in 1892 a six lift holder having a capacity of 12,200,000 cu. ft. was installed at East Greenwich. These two holders remained the largest gas holders in the world, until the construction of the first fifteen million cu. ft. holder at the Astoria Works in 1926. The first five million cu. ft. holder in America was built at Ravenswood in 1894.

While the manufacture of suitable steel plates of sufficient size and thickness for large steel tanks and

the equipment and skill for their fabrication and erection permitted the construction of gas holders up to ten million cu. ft. capacity, the requirements of the Industry could not be met within that limitation. The designing and building of these large gas holders brought up new problems to be met. The stresses of the crown sections were very great, requiring massive and expensive construction and the weight of water reached sixty to seventy thousand tons, in addition to the weight of the structure itself. The support of such an enormous load meant a big outlay for foundations, unless the soil conditions were very favorable.

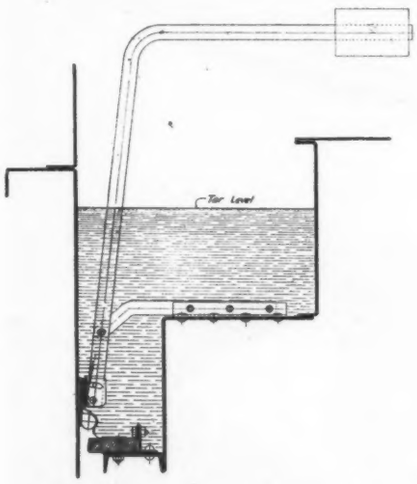


Fig. 8—Details of M.A.N. Seal.

It is not strange, therefore, that designers sought to meet these difficulties by inventing a type of holder which could function without the use of a water tank. While many schemes for accomplishing this were proposed many years back, it does not appear that any of them were tried until the first dry holder was built by the M.A.N. in Germany, about 1909. That Company built a few of very small capacity and did not attempt one of any considerable size until 1916, when owing to the scarcity of steel under war conditions larger ones were erected, two of which had a capacity of one million cu. ft. each.

After the World War, the M.A.N. Company displayed great enterprise in improving the design and in obtaining contracts for the construction of this type of holder throughout the world. Its advantages particularly for large capacities, became immediately apparent with the result that the majority of the large gas holders in the world erected in the last ten years have been of this design. The twenty million cu. ft. waterless holder in Chicago, placed in service in 1928, is the largest gas holder of any type ever attempted. There are also in the United States five fifteen million cu. ft. holders of the M.A.N. design; the largest outside of the United States being a twelve million cu. ft. holder at Oberhausen, near Essex, in Germany. Other large holders of this size in Europe are a ten million cu. ft. holder at Hamborn, another of the same size at Stuttgart, an eight million cu. ft. holder at Hamburg, and another of the same capacity in London. There are now 232 gas holders of the M.A.N. waterless type in service throughout the world, of which 49 are in North America. Their total storage capacity is about six hundred and fifteen million cu. ft.

In 1925, the firm of August Kloenne of Dortmund, Germany, introduced a new type of dry holder which differs from the M.A.N., principally in the construction of the piston. There have been built about 35 holders of this design, the largest of which is one of six million cu. ft. capacity at Syracuse, New York, and another of the same size at Paris, France. Holders of the Kloenne design have also been erected at Reading, Pa., and Kalamazoo, Michigan.

In 1932, a dry holder of a third design, known as the Bamag, was erected in the suburbs of Berlin, Germany. Figs. 8, 9 and 10 indicate

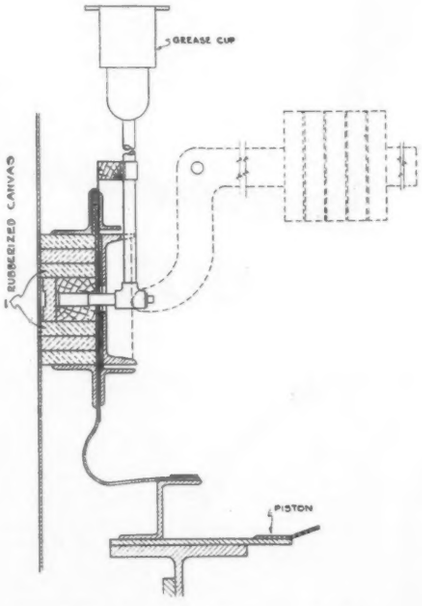


Fig. 9—Seal for Kloenne Holder.

the characteristic features of the M.A.N., Kloenne and Bamag holders.

One structural difference between the M.A.N. and Kloenne holders is that the former has a shell of polygonal form, while the shell of the Kloenne holder is cylindrical.

In 1933, the Bartlett Hayward Company erected at Biddeford, Maine, a waterless holder of a modified M.A.N. design, the essential difference being that the shell is cylindrical and the piston floats up and down guided by a massive center post, all guide rollers being omitted.

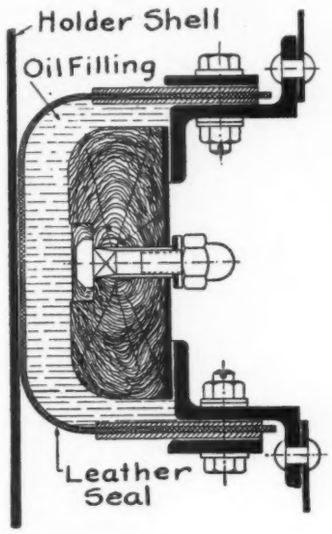
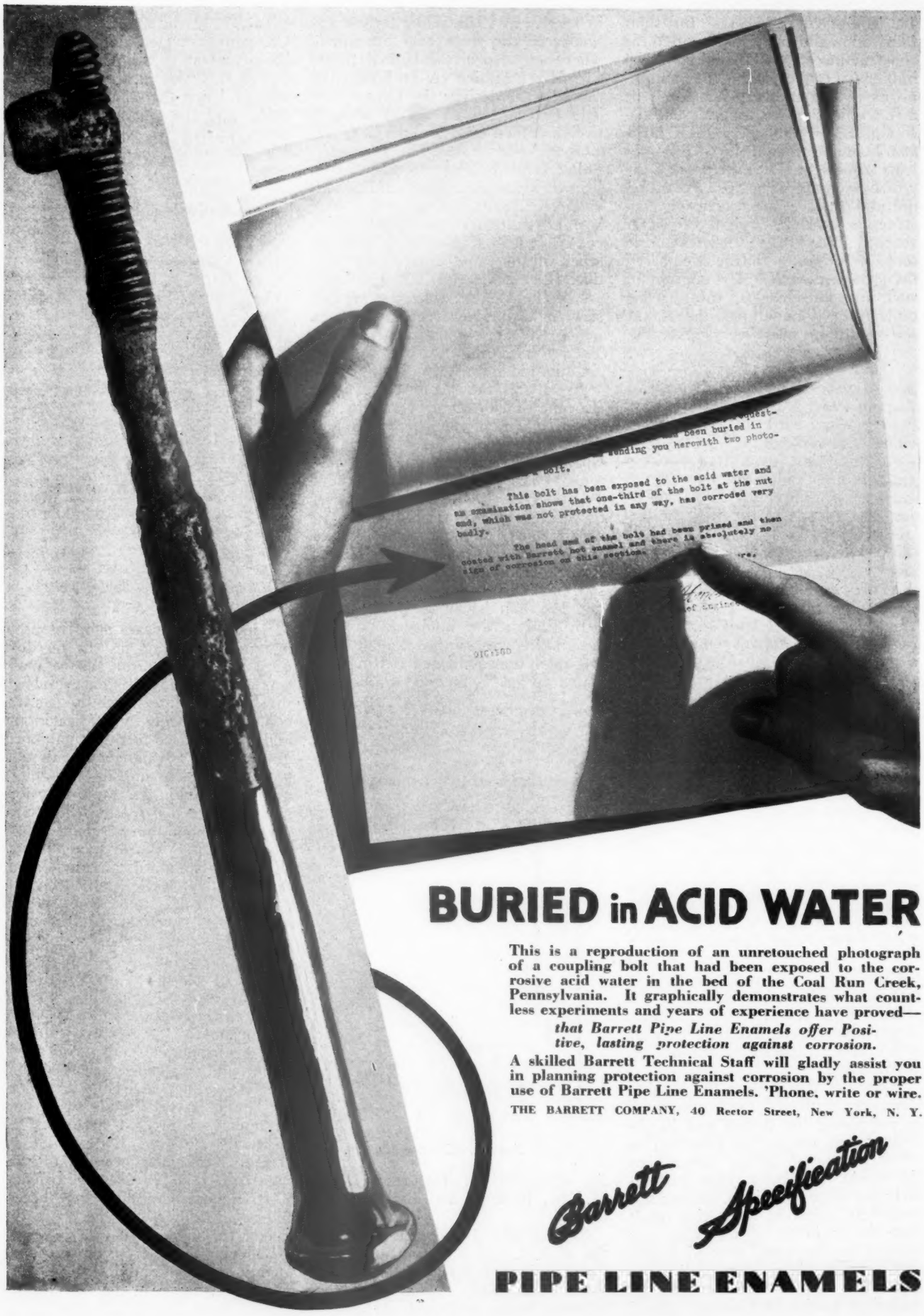


Fig. 10—Bamag Seal Details

Some twenty years ago, the problem of gas storage in the territory of a western natural gas company was solved by installing a cylindrical pressure tank into which the gas was compressed during the off peak hours and then released as the demands required. The advantages of this type of storage were quickly recognized and along with the rapid developments in the distribution of natural gas throughout the west and southwest after the World War, it was adopted as standard construction for that kind of service. In 1924 the Chicago Bridge and Iron Works adapted the spherical gasolene storage tank, a number of which had already been built by them, to the storage of gas under pressure. This type of storage tank has become known throughout the Industry as the Hortonsphere. The cylindrical tank with hemispherical ends, lying horizontal and supported by steel and concrete saddles, is usually known as the "bullet" type. Some times bullet tanks are erected in a vertical position. Both of these types of pressure tank have been completely standardized and in size have reached 60 ft. in diameter for Hortonspheres, and about 130 ft. long by 30 ft. diameter for bullet tanks.

Believing that there is always room for improvement and desiring to perpetuate my name in the Gas Indus-

(Continued on page 148)


been buried in
sending you herewith two photo-
bolt.
This bolt has been exposed to the acid water and
an examination shows that one-third of the bolt at the nut
end, which was not protected in any way, has corroded very
badly.
The head end of the bolt had been primed and then
coated with Barrett hot enamel and there is absolutely no
sign of corrosion on this section.

BURIED in ACID WATER

This is a reproduction of an unretouched photograph of a coupling bolt that had been exposed to the corrosive acid water in the bed of the Coal Run Creek, Pennsylvania. It graphically demonstrates what countless experiments and years of experience have proved—

that Barrett Pipe Line Enamels offer Positive, lasting protection against corrosion.

A skilled Barrett Technical Staff will gladly assist you in planning protection against corrosion by the proper use of Barrett Pipe Line Enamels. 'Phone, write or wire.

THE BARRETT COMPANY, 40 Rector Street, New York, N. Y.

Barrett Specification

PIPE LINE ENAMELS

Development of Gas Distribution Tools and Equipment During the Past Seventy-Five Years

By W. A. DUNKLEY

Supt., Gas Dept., Memphis Power & Light Company

The service man of 30 years ago was a work shop on two wheels.

DURING the seventy-five years that the *American Gas Journal* has served our industry a remarkable evolution of methods and equipment has taken place. This period represents nearly two-thirds of the life of the Gas Industry in America to date. Seventy-five years ago, the gas industry had but one outlet for its product, namely, in the production of light. The gas range and gas water heater had not yet come into existence—househeating with gas was then regarded, if at all, as little more than a dream. Even the wildest imaginations would hardly have pictured the enormous use of gas for industrial purposes which has since been developed.

Many of our great cities of today were small towns then and construction and maintenance work was conducted on a relatively small scale. Manual labor for practically all operations, and horse-drawn or hand-drawn transportation of materials, were almost exclusively in vogue.

The growth of urban populations during the past three-quarters of a century has been enormous and the extension of city gas distribution systems has usually followed this growth very closely. The discovery of great natural gas pools and the efforts to get this gas to city markets has covered many parts of our country with a net-work of great transmission lines interconnecting great gas fields and bringing gas to markets, in some cases more than a thousand miles away from the source of supply. Such great strides in the extension of gas pipe lines and distributing systems to handle the vast volume of heating and industrial business which has been taken on by gas companies all over the country, has necessitated a rapid evolution in the tools and equipment by which such work is done.

Many underground structures make it difficult or impossible to use mechanical equipment for digging and backfilling but whereas the pick and shovel, bar and sledge were once man's only means of preparing for underground construction and maintenance work, these tools are supplemented today by a variety of power driven equipment which does much to minimize the time and labor involved.

Horse Drawn Drip Wagon used in Philadelphia in 1899.

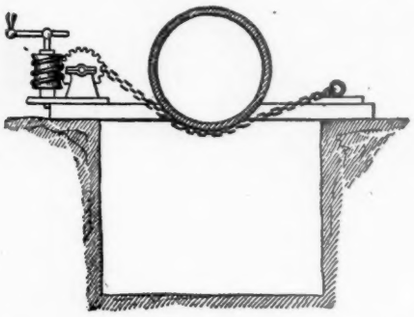
Influence of Internal Combustion Engine

One of the chief factors in making power driven tools available for our work is the development of the internal combustion engine, stimulated by evolution of the automobile industry.

The gasoline motor has found numerous applications in gas distribution work. Some of these uses will

be outlined in the following.

The gasoline engine driven air compressor forms the nucleus of a number of power applications to distribution work. This compressor may be driven from an automobile engine through a special drive or as is most often the case, it may be direct-connected to its own independent gasoline engine.



Apparatus for lowering Mains into Trench, designed by Lewis A. Boore, Buffalo, N. Y., Gas Light Co., 1888.

A large variety of air tools has been developed, not only for opening paved streets in advance of construction and maintenance work, but also to perform certain operations on the underground structures themselves.

The air-driven paving breaker is one of the most important of these air tools and its use enormously decreases the hand labor necessary in opening paved streets.

For locating leaks under pavements the air-driven jack-hammer affords a ready means of making small holes through pavement in a minimum time. A carefully planned exploration with leak detectors, through such holes, often avoids much pavement disturbance.

The air compressor also furnishes the motive power for driving tapping machines operated by air motors. Such equipment can be worked in a relatively small space and greatly decreases the physical work and time required, especially in making large taps. In backfilling, air-driven tampers are frequently used, giving quicker and more perfect consolidation of the earth in the trench. Another function of the portable air compressor is to operate the air guns used in caulking joints, especially when cast lead or wool lead are used as packing materials. While many hundreds of miles of such construction are now in use, it seems that in the gas industry at least, caulked joints are becoming rapidly a thing of the past as applied to new construction work, the caulked joint being supplanted by a variety of mechanical joints now on the market. Even in making up mechanical joints however, the portable air compressor has a place in driving air motor operated wrenches permitting the mechanical joints to be made up very rapidly.

Saving Pavements

Work in highly improved streets is likely to be difficult and expensive at best, and the tearing up of pavement is likely to be frowned upon not only by city officials but also by the general public as well. It is important, therefore, that such work should be kept at a minimum and that all street opening should be of the minimum size necessary to accomplish the purpose of the excavation. Many companies make it a practice to anticipate new pavements by laying mains and stub services in excess of immediate requirements ahead of paving; but even so, it is sometimes necessary to make pavement openings to install services in locations where the need was not anticipated or where the required size is greater than that of the stub service installed, perhaps several years previous. In such cases the service jack which pushes the service pipe through the soil by main force, or some form of auger which bores a hole for the service, makes an enormous saving in the cost of pavement replacements. Mechanical augers, power-driven, the spoil being washed out by water under pressure, have appeared on the market during the past few years and are said to be very successful in making long bores with great accuracy.

The Trenching Machine—A Labor Saver

During the past several years the gasoline driven trenching machine has found an increasingly important place in new construction work. This applies not only to the great cross-country transmission lines but also to suburban trenching work in cities. The trenching machine of a few years ago was, in most cases a large, heavy, cumbersome affair which could be used to an advantage only in comparatively open country, under favorable conditions. During the past ten or fifteen years however, light trenchers, some of the wheel-type and others of the bucket-type, have been developed. These can be maneuvered even in fairly congested districts where soil conditions and underground structures permit. These machines will, under favorable conditions, dig over ten feet of trench per minute and often make possible enormous savings in time and labor involved in trenching. The extent to which such machines can be used often depends upon the faith and ingenuity of the operator. Frequently a trench can be dug in the narrow space between curb and sidewalk, even where telephone and power poles have to be dodged at intervals. Some trenching machines are equipped with movable spoil conveyors which can be moved from one side of the machine to the other to give clearance to such obstructions. Whether a machine can be economically used in any given location under such conditions will depend to a great extent on the competing cost of labor.

One of the most important accessories to the light trenching machine is the trailer, on which it is transported rapidly from job to job. The trencher mounts or dismounts the trailer by its own power and the trailer is coupled to a truck or tractor which transports it rapidly from place to place.

With the development of the trenching machine considerable attention has been given to the development of backfilling and tamping

Pusher type back filler.

machines. The backfilling machine may be of the pushing type or of the drag line scraper type. The choice of type will depend to a great extent upon the conditions under which the majority of the work is to be done and the space available for maneuvering the machine.

The Tractor Is Often Useful

In big pipe laying work the gasoline driven tractor is often a very useful piece of equipment. It not only furnishes the motive power for hauling pipe but also, when equipped with winch and boom, assists greatly in unloading and handling pipe from truck to ditch. At times the tractor when used to pull a hand operated scraper can be used to considerable advantage in backfilling.

Where the amount of heavy pipe to be handled into the trench does not warrant the use of a tractor, various forms of steel derricks equipped with winches are available. These are readily mounted over trenches and make possible the handling of pipe of large sizes with a minimum of physical exertion and with less danger to construction forces than when the handling of such pipe is attempted manually, relying chiefly upon the main strength of a number of individuals.

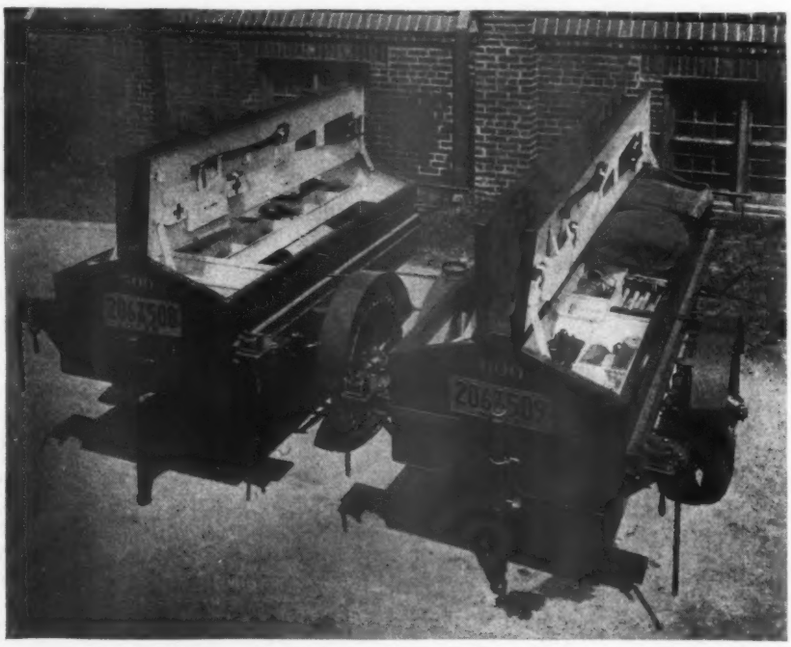
Another piece of equipment which finds frequent application in city work is the small gasoline motor-driven concrete mixer. This frequently saves a great deal of labor in placing concrete pavement as compared with hand mixers. In some cities, however, a still more economical method of replacing concrete pavement is afforded by concrete companies who furnish ready mixed concrete from a central plant on the job where wanted and often at a lower cost than it could be mixed even by the small portable machine.

The gasoline motor furnishes a reliable and convenient means of performing many other incidental duties which would be more or less laborious if done by hand. For example, motor driven pumps are frequently used in clearing ditches of water after heavy rains or where there is a constant seepage of water into the trench. These pumps are of various forms depending upon the nature of the water to be handled. Gasoline motors are frequently geared onto diaphragm lift pumps and in some cases gasoline driven Centrifugal pumps give a means of ejecting large volumes of water from regulator vaults and trenches in a short period of time.

Another pump application which is very useful in manufactured gas property is the motor-driven drip pump. This is usually mounted on a tank truck and may be driven through a special transmission from the truck motor or, in cases where electric trucks are used, it may be driven by a motor getting its current from the truck battery. The motor drip truck permits covering drips over a much greater radius than was possible with facilities of earlier days. Not only is movement from place to place more rapid but each drip can be pumped more quickly and with much less physical exertion.

Field Welding

Reference has already been made to the use of mechanical equipment



Modern Trailers for Emergency and General Distribution Work.

Acetylene Welding occupies Important Role in Distribution Work

in jointing cast iron pipe. In many cities, however, a large mileage of steel pipe is being laid each year in normal times and, while this pipe, like cast iron, is frequently coupled by mechanical couplings with rubber gaskets, there has been a great development in welding methods especially during the past ten years. The welded pipe line offers many advantages from the standpoint of giving a homogeneous construction with few, if any, joints made up from materials different from the composition of the pipe itself. The ease of cutting steel pipe with the acetylene torch and the adaptability of the welding processes, whether gas or electric, in making angles and branch connections has many advantages. For small jobs where gas welding is employed, acetylene and oxygen are furnished under pressure in steel tanks, but in larger work, acetylene generators for gas welding and gasoline motor-driven generators for electric welding are available.

Extended Use of Steel Pipe

With the extended use of steel pipe has come the problem of its adequate protection against corrosion. Many pipe coatings and wrappings have been suggested and some have found very extensive use. Some of these coatings, such as the enamels, are applied in the molten condition. Close regulation of temperatures and ready portability have resulted in the development of oil heated melting kettles.

Where some form of wrapping is used in conjunction with the bituminous, asphaltic or other coating material, this wrapping is sometimes applied at the pipe mill but at least one machine has been devised which

will apply a spiral wrapping of asbestos felt, paper, or fabric, to even the larger sizes of pipe, in the field.

Where coating is applied to pipe as a cold application, sprays operated by compressed air are available. Sprays have also been devised, though their application is as yet limited, whereby a coating of molten metal can be sprayed onto steel pipe.

Where an insulating coating is applied to steel pipe, several devices have been developed to test the coating rapidly for pinholes, cracks, and skips ("or holidays"). Among these detectors is one which utilizes the neon tube, so commonly applied now to electric signs. One electrode of the apparatus is connected to the pipe, the other is passed rapidly over the coating and the neon tube glows when it passes over an imperfection in the coating.

A chemical method, whereby the passage of electric current through the coating is caused to make a pattern of the imperfections on a chemically treated paper, is also frequently used.

Soil Surveys Becoming Important

Hand in hand with the development of coatings for steel pipe during the past few years, studies have been made of the chemical and electrical conditions which promote corrosion of steel in various soils and localities. These studies have led to the application of instruments used in other industries to the problems of the gas industry, and the development of many special instruments. Sensitive voltmeters are used to determine the relative potential of gas mains and services to the earth and other underground structures. The conductance or resistivity of the earth itself along the routes of proposed pipe lines, together with the chemical properties of the soil are determined by electrical instruments and chemical tests, in order that the advisability of coating or not coating a line may be determined. Much remains to be done in the solution of such complex problems but science is proceeding steadily in the work and the gas industry is cooperating.

Gas Conservation and Safety

Not only has great progress been made during the past seventy-five years in the mechanical operations heretofore mentioned, but also the industry has been quick to grasp the possibilities of various scientific developments in other industries for promoting safety in its distribution operations. Take, for example, the location of gas leaks. Seventy-five years ago and even at a much more recent date, the gas man's nose was his sole guide in detecting gas leakage and estimating its seriousness until the leaking pipe of the distribution system was actually uncovered. With the introduction of natural gas it was quickly realized that more scientific means of leak detection than those afforded by the nose, were desirable. Natural gas usually has very little odor and even with the addition of an odorant, the intensity of the odor in any particular case, or the direction from which it is coming is difficult to gauge from the sense of smell. For the detection of gas in manholes, sewers, basements, etc., some form of miners' safety lamp has been extensively applied to gas detection. More recently various forms of electrical leaks detectors have been developed and applied to this problem. With the electric gas leak detector the presence of even minute traces of combustible gas in manholes or other underground structures can be detected. Where exploring over mains to locate leakage through barholes, the instrument affords a convenient means of gauging the concentration of gas at various points, thereby materially assisting in tracing out the source of the leakage.

No less important than the wonderful development of tools and equipment during the past seventy-five years have been the improved facilities for supervision of work under way. The horse and buggy of the distribution foreman of the "gay nineties" may have been regarded as the acme of perfection in those times but would be entirely inadequate to keep up with the modern tempo. The modern automobile enables the general foreman to cover much more territory in a much shorter time and to spend less of his valuable time between jobs. This is especially important, now that distribution systems in the average cities have grown to far greater proportions than in the early days. Most of the construction work is around the fringe of the distribution system as it extends into new territory. Obviously, the ability to cover great distances in a short time is extremely important.

Also of prime importance is the ability of modern automotive equipment to get emergency crews where needed in the least possible time. In modern distribution systems many of them operating at intermediate or high pressures, leaks are liable to occur. Danger while always present from such occurrences, is greatly minimized by the ability of emergency crews to reach the scene as quickly as possible. Frequently such emergencies occur at night and in poorly lighted localities. In such cases one or more spotlights attached by extension cords to the battery of the service truck greatly assists in furnishing illumination for the emergency repairs.

The handling of leaks is another matter in which science has greatly improved working conditions of today as compared with those of a generation or so ago. If it is necessary to work in gas-filled locations, various types of gas masks are available. Equipped with a good gas mask a man can work in comparative safety. In some atmospheres, where there is no deficiency of oxygen, a gas mask of the Canister type, such as was developed in the World War, finds application.

Where there may be a deficiency of oxygen, hose masks supplied with air from a blower located outside the gas-filled space are available. Equipped with one of these hose masks, a workman may venture into a gas-filled atmosphere to the limits of his air supply hose. Although any type of mask is an encumbrance, its use, under some conditions, greatly facilitates repair work.

Care of Tools and Equipment

Modern efficiency methods necessitate much greater care of hand tools and equipment than was formerly considered necessary in construction work. It is not practical for each man to take home with him at night the tools which he uses during the day and these must be properly cared for to prevent loss. Attractive and sturdy high speed tool carts have been devised and now extensively used for storing tools and conveying them from job to job. Not only does an attractive tool box or trailer promote efficiency and save loss of tools, but it also is a good advertisement for the company to which it belongs. Often these tool boxes are attractively labeled with the company's insignia and in some cases with a slogan which suggests the use of gas for fuel. Since this equipment is moved from place to place it has the nature of a traveling ad.

Underground Pipe Locators

Our predecessors in gas distribution were usually very thorough and conscientious in their work, but unfortunately many of them overlooked the importance of making adequate records of mains and services for the convenience of their

(Continued on page 146)

QUALITY EQUIPMENT
THAT MEETS YOUR REQUIREMENTS

The famous little machine that has since its conception played so large a part in the development of the Gas Industry.

The CLEVELAND BABY DIGGER

For over thirteen years the Cleveland Baby Digger has blazed a trail of efficiency and economy in trench excavation.

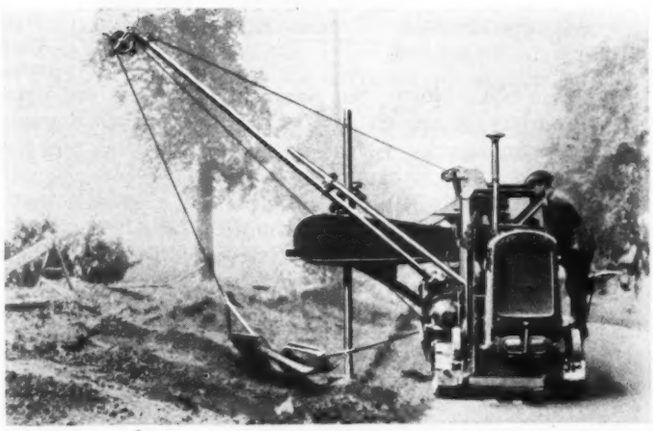
Because of year in and year out constant devotion to quality and continuous intensive study of requirements, the Baby Digger is a most distinctive type machine; above all practical and always extremely usable.

A small, compact, mobile unit, packed with astonishing power, speed and ruggedness, the Baby Digger is the logical answer to your problem of economic trench digging.

The 1934 model will surprise even those who have been long accustomed to Baby Digger performance and value.

The CLEVELAND TAMPER-BACKFILLER

Keep pace with modern trench construction methods by cleaning up your job as you go, with the Tamper-Backfiller. This compact, crawler mounted, one-man operated unit enables you to backfill and tamp simultaneously or separately, as you wish. It does both jobs better, quicker and more economically than any other method assuring a permanent replacement of the dirt without settling.



The CLEVELAND PIONEER

For real economy in digging trenches up to 10 feet deep and as wide as 4½ feet, the 1934 model Pioneer is the last word in ladder-type trench digging machines.

The Pioneer has the patented "Pivot-Conveyor." Enables you to instantly discharge surplus dirt into trucks and discharge at any point in 180 degrees arc.

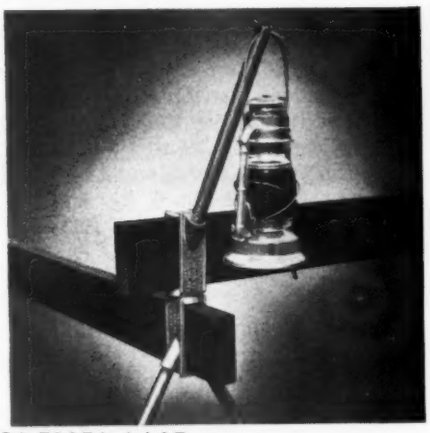
Extremely compact, mobile and rugged, the Pioneer delivers fast, powerful performance where large diameter pipe (20" - 30" - etc.) is to be installed.

All Cleveland machines are easily transported on special-built pneumatic tire trailers. Prices more than ever attractive. Request will bring complete information without obligation.

The CLEVELAND TRENCHER CO.

"Pioneers of the Small Trencher"

20100 St. Clair Ave. **Cleveland, Ohio**



CLEVELAND TRENCH GUARDS—

Strongly made of rust-proofed iron, with patented swivel heads, these interconnected guards form a *complete unbroken* fence, alongside or surrounding excavation. Built-in supports place flags or lanterns in full view from all directions. Easily dismantled or set up. These practically indestructible "Trench Guards" are the cheapest and most effective method yet devised for protecting open ditches, preventing accidents.

An early American pipe mill, showing hand-operated draw bench

Brief History of American Gas Distribution Practice

By ERICK LARSON

Long Island Lighting Company

DELVING into the ancient archives in search of gas distribution landmarks is fascinating, as it fires the imagination with enthusiasm for the future and provides interesting diversity through insights into numerous industries contributing directly and indirectly to advancement in our own specialized field. Many particularly interesting personalities who have advanced our practices through their foresight, made most of their contributions before any active direct participation in the gas industry. Honor is due the gas operating staffs in California for their many achievements in gas distribution technique. Obsolescence is a much discussed subject especially as to the capacity of equipment. The picture of rapid development presented by an intimate study of history furnishes many reasons for the lack of capacity for the non-permanency of equipment.

The first gas mains laid in 1806 were leaden pipes; cast iron soon followed, both being in use at that time for the conveyance of water.

Cast iron pipe antedates by almost 200 years the birth of our own industry. There have been various developments in methods of casting, valuable in themselves—as they produced arguments for salesmen—but little outstanding until the introduction of centrifugal casting. The process was invented by a Brazilian engineer and introduced into England and Canada for about three years previous to its debut in the United States in 1922. In 1922 it could only be produced in six to twelve inch diameters and twelve foot lengths which has been increased, until now three to twenty-four inch diameters and twelve, sixteen and eighteen foot lengths are available.

Murdock used not only wrought iron for service but also tin and copper tubes, not as corrosion resisters but as an economy, much of the material being second hand. In England and on the continent cast iron pipe for mains and wrought iron for services was early adopted as standard. The rapidity with which the standard increased the demand for tubing is indicated by a patent secured by Osborne, an Englishman, in 1812, on a machine for "Welding and making barrels of *fire arms* and other cylindrical articles." By 1824 the source of demand for tubular products had so changed that James Russell in filing a patent wrote, "An improvement in the manufacture of *tubes for gas* and other purposes." These patents covered butt-welding processes. In 1825 Cornelius Whitehouse invented the "bell" process of butt-welding, commonly used today with minor mechanical improvements.

First Tubes

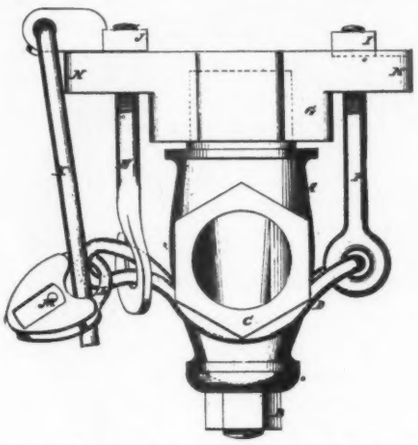
Considerable interest was manifested in the first tubes produced by the Wanalancet Tube Company of Massachusetts on November 3rd, 1849, due to the wide range in the size of their products which was ¼" to 3" wrought iron pipe.

As was evident in the World War period, the demand for gas and materials used in the gas industry increased during the Civil War period, 1861-1865, to such an extent that several mills were established west of the Alleghanies and one in Chicago in 1865.

In 1869 Flagler Brothers of Boston, Mass., which later became the National Tube Company, was incorporated for the manufacture of tubular products. This firm was destined to make pipe history with a rapidity that must have left competitors staggering and produces only admiration for the owners and operators. In 1869 they produced tubes between 2" and 9" in diameter. In 1872 they moved from Boston to McKeesport, Pa., to be at the source of iron and coal supply, and made an outstanding progressive step in the adoption of Siemens regenerative furnaces to mill practice. These furnaces used natural gas and tripled the production possible with old types. By 1880 with skepticism and doubt on the part of other rolling mill operators, Flagler's increased the size of lap-welded pipe to 15" O.D. In 1887 they again improved their mechanical equipment, making 24" possible, and in 1897, 30". In 1894 they built the first back-charging furnaces which increased the production of heating furnaces three to four times. In 1897, with electric motors still in their infancy, Flagler's completely equipped rolls and all other machines in one mill with electric power.

The satisfactory welding of the longitudinal seams of wrought iron pipe by butt, lap or hammer welding was the most difficult of all operations. To assure the quality of their tubes, Flagler's in 1869 adopted as standard practice the hydraulic testing of every tube at pressures from 300 to 350 lbs.

As is true today, many achievements become accomplished facts only when those who are intimately connected with every step in the process will lend themselves with their utmost skill to produce a finished product. When accomplishment is made in spite of lack of cooperation, often the enthusiasm of hard thinking, calculating engineers is evident in their reports of the final product. Such is evident in a paper entitled, "The Manufacture of Welded Steel Tubing," by Thomas



Lock Stop Cock Invented in 1871 by J. Evans Jones.

J. Bray, Superintendent of Tube Department, Riverside Iron Works, Wheeling, West Virginia, given before the Engineering Socity of Western Pennsylvania on January 17th, 1888. He mentions the first attempt to weld steel into tubes when 30 tons of steel were made into tubing in August, 1887, saying, "welders at the furnaces by reason of their prejudices against steel subjected it to abuse by severe over-heating; yet, strange to say, every piece of that lot made a sound saleable pipe." His reward was the almost immediate decision of that mill and many others to produce nothing but steel tubing, in place of wrought iron. In 1890 less than 5% of tubular products were made of steel, whereas by 1920 the proportion had grown to 95%.

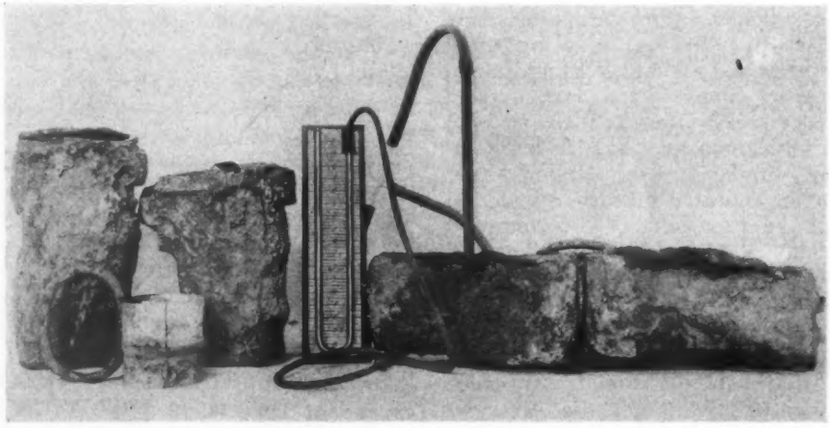
The difficulties of producing a good quality of longitudinal seam in wrought pipe had encouraged many attempts to produce seamless tubing. The first commercially successful seamless tubing was produced in Shelby, Ohio, and to this day seamless is often termed "Shelby." The cold drawn seamless tubing first produced was used exclusively for the manufacture of bicycles. Today seamless tubing can be produced in sizes from a hypodermic needle to 26"; the smaller sizes are first produced in larger sizes and drawn down to the diameter desired. Development in the seamless process has been rapid considering that butt-welded pipe has only been produced from ⅛" to 4" and lap welded from ¼" to 22". Hammer weld pipe has been made in 10' diameter size, while electrically welded pipe is produced from 15" to 72" diameter.

More recent developments in the manufacture of steel pipe have been the first commercial production of stainless steel in 1914 and electrically welded seams in 1921.

The American gas industry has one unique feature—the use of wood pipe. A perusal of foreign literature fails to indicate any duplicating practice, unless the ancient use of bamboo pipe by the Chinese be considered. The origin of wooden mains is difficult to determine but records show Chicago laying considerable in 1850. In many places judgment in the selection of wood for mains was justified, considering the resulting life. In 1870 and 1871 a line of wooden pipe was laid from West Blumfield, N. Y., to Rochester, a distance of 25 miles. Twenty acres of the best Canadian white pine were cut to furnish the pipe, which was delivered in lengths varying from two to eight feet and having an O.D. of 12½" and an ID of 8". The bells were made by enlarging the ID to 10" for a depth of 4" from the pipe end and the spigot being correspondingly decreased in OD. The lengths were tarred both inside and out. Joints were made tight by dipping in hot tar and were then immediately driven home. Iron gate valves of quite similar design to those now used were installed at intervals. It was originally planned that the gate valves would never be completely closed but, since no mechanical means were incorporated in the design to prevent complete closing, catastrophe resulted. After more than 20 miles had been completed a new engineer in charge decided to make a full length test and closed a valve completely, resulting in many of the joints coming apart and the splitting of pipe lengths. All joints found leaking originally and after subjection to pressure, were repaired by wrapping with burlap soaked in tar until the burlap available ran out and woolen blankets torn in strips were substituted. The line when finally completed could carry only one pound pressure without unwarranted loss and the resulting restriction in capacity led to its abandonment soon after completion.

In 1871 there are records of the Hyde Park Gas Company laying 3", 4", 6" and 8" wooden mains in Chicago; in 1877 the Lockport Company and in 1882 in several locations in Wisconsin. Red lead putty was used as the sealing medium in the joints. It is curious to note the similarity between present day discussions on unaccounted-for gas as affected by various types of mains and joints and the defense of wooden mains made in 1875 in a very able paper presented in Canada. As late as 1880 a summary of gas statistics placed the average unaccounted-for at 16%, while some companies reported 50 to 60%.

The controversial subject of expansion and contraction of steel mains has been inherited and revivified in recent years. In 1907 one engineer recommended no expansion joints; another, none up to 10" diameter and one every 160' beyond that size; and still another, one every 1,000' on all sizes of main used for high pressure, with the additional caution of firmly anchoring the pipe every 500 feet. A curious reason for anchors every 500' and on all bends was to prevent the damaging effects of "gas hammer" which was com-

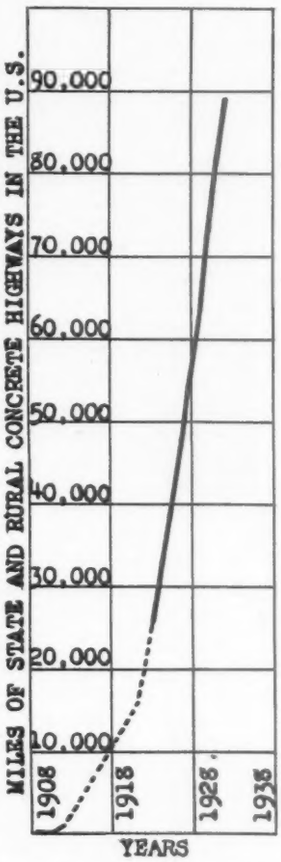


Clark mechanical joint with rubber sealing ring held together with two W. I. rings forced over lugs laid in 1870. Joint still tight at 2 lb. pressure.

pared to "water hammer." It would be interesting to know whether any engineer at that time had ever heard "gas hammer" or whether some water engineer when employed in the gas industry assumed his water experience to apply in gas practice. The study of expansion and contraction was apparently not seriously considered until 1924 when an A.G.A. sub-committee on ground temperature determinations under E. F. Kaufman as chairman reported results on water lines, and again in 1926 and 1927 when studies were undertaken by the Bureau of Mines.

In the period 1905 to 1907 purging of mains first aroused interest and text books recommended the use of wire mesh on outlet pipes, giving precautions to follow in larger sized mains but still giving the value of smell as preferable, with certain calculations as a check for the determination of complete purging. No mention was made of inert gases.

Corrosion is a subject which apparently received its full proportion of time when mains were either wooden or cast iron. In 1893 a paper written by D. J. Spataro covers the troubles experienced in the corrosion of cast iron pipe. Oil lines laid in Mexico previous to 1900 indicate the advancement of knowledge of soil corrosion by the fact that, although coated, the lines were also wrapped with asbestos felts. The advantages of wrapping were apparently obvious to some engineers, as in 1907 and 1913 additional Mexican lines were coated and wrapped with asbestos felts. In 1915 the Oklahoma Gas & Electric Company similarly wrapped, and the practice repeated on larger scales in 1921 in Louisiana, California and Oklahoma, and in 1927 in Texas and Kansas. The slow adoption of better methods in not only pipe coating but many phases appears to be a characteristic of the gas industry and is often politely termed ultra conservatism. Although the National Tube Company had wrapped at the mill on specification, the first attempt at commercial mill wrapping was in 1928.



Growth of Concrete Highways in U. S.

The Wailes Dove Hermiston Company were pioneers in the use of enamel coatings in this country. Enamels were originally produced by them for marine protection in 1891 and introduced for the same purpose in the United States in 1896. Enameling of sub-surface pipe lines was first attempted in 1910, although it was not until 1913 and 1914 that it advanced beyond the test basis when 2,000 feet of 66" steel water line was coated in Brooklyn, N. Y. In the same year it was first applied to oil and gas lines for the Shell Oil Company of California. During the World War interest in coating waned, all efforts being concentrated on mass production. In 1925 an important step in the use of enamels occurred in the origination of the sling application method, the first practical attempt being made by the Wailes Dove Hermiston Company on a 6" gas line buried in cinders at Coatesville, Penna. The pioneers on that job may recall that the hot enamel melted the solder out of the only large sprinkling can available locally and that the job was completed using an aluminum tea kettle.

Up to 1926 all enamels used for pipe line coating had an asphalt base, but in 1926 on a line in Glassboro, N. J., a cold tar product was applied for the first time and by 1927 its use had become general.

That the corrosion problem was well recognized soon after the turn of the century is evident in the burial of test specimens by several companies. An interesting description of a prescription for a coating found was a heated mixture of tar, lime, tallow, rosin and crude rubber into which mixture the pipe was immersed. By 1918 a knowledge of the causes of corrosion had extended to the point where several were recommending the use of chemicals such as lime and other soluble hydroxides around the pipe, but their value was soon determined as only temporary.

The now commonly known inhibitive types of greases were originated in 1916 and first applied to gas lines in 1918 and the originating company developed an impregnated cloth wrapper in 1921.

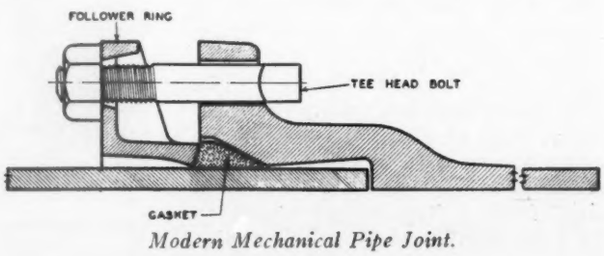
In the mitigation of damage by electrolysis most European companies have been and are far in advance of our practices due to the early legislative efforts to minimize stray currents. The Bureau of Standards by 1913 had made several studies and indicated the value of further studies and by 1918 had investigated the method of cathodic protection using that term as a description as it occurred in a number of patents.

First Use of Rubber

The use of rubber in joints apparently was first commercially adapted in the Ziegler joint installed in Wooster, Germany, in 1847. Rubber was used in joints in England in 1863, in Nice, France in 1870 and in Lyons, France, in 1878. S. R. Dresser was undoubtedly one of the first in the United States to realize the value of rubber in joints as indicated by patents he secured as early as 1887, rapidly followed by many others in 1888 and 1889. Early advertisements of S. R. Dresser are worthy of note as he continuously emphasises his personal responsibility for the quality and efficiency of the joint he produced, indicating that most of them were the products of his own vivid imagination. In 1900 he said, "Leaded and fittings are not to be considered, as they always leak." While a manufacturer this statement was not made without numerous operation engineers attesting to the validity of the contention and a willingness to support it with actual facts.

While S. R. Dresser's original experience was in natural gas, he was quick to adapt his products to manufactured gas and on finding that the

(Continued on page 90)



Modern Mechanical Pipe Joint.

They All Have The Same Characteristics!

The Foxboro Bell Type Meter for Low Pressure Gas Measurement.

◆ Your flow conditions may require a Pressure Compensated Meter, a Uniform Flow Scale Integrating Meter, or a Low Pressure Bell Type Meter. You can select any of these Foxboro Meters with the assurance that they all have the characteristics so essential to continuously accurate measurement.

Under all conditions Foxboro meters are:—

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◆ PRESSURE COMPENSATED METER. The Foxboro Pressure Compensator makes it possible to record and integrate gas flow accurately at variable pressures. The chart records are compensated as well as the integrations. There are no complicated mechanisms in the Foxboro Pressure Compensator. It operates effectively and efficiently—without friction and lost motion.

◆ UNIFORM FLOW SCALE INTEGRATING METER. This unusual Meter has a wide flow rangeability of 10 to 1. The specially designed integrator in this instrument gives accurate integration over the entire 10 to 1 ratio. One of the important advantages of the even scale chart is that temperature and pressure records can be made on the same chart with the flow record.

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◆ BELL TYPE METER. This instrument is ideal for low pressure gas measurement. It may be used with any of the primary devices—orifice plate, flow nozzle, venturi tube, or pitot tube. The flow capacity of this meter can be changed easily by changing the size of the primary device.

Write for complete information on any of the above meters!

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BRANCH OFFICES IN ALL PRINCIPAL CITIES

• • COMPLETE INSTRUMENTATION FOR GAS DISTRIBUTION • •

History of Distribution Practice

(Continued from page 88)

rubber in joints was affected by condensates, patented the lead and duck tipped gaskets on July 16th, 1912.

Insulating joints became a necessity soon after the introduction of electricity. By 1900 there is record that in five cities alone a total of 128 miles of main had been installed with an insulating coupling on every joint.

The bell and spigot clamp is an adaption of steam practice to gas. The M. B. Skinner Company patented a pipe clamp in 1898 but it remained for S. R. Dresser to realize the potentialities when applied to gas, as by 1903 he had introduced a clamp which was held in place by hook bolts, the hook applied in back of the bell which he superseded by a bell ring in 1906.

The form of slip couplings in common use today was originally designed and patented by S. R. Dresser in 1887. The style of coupling most common today was first used at Malta, Ohio, on five miles of 5⅝" casing in the fall of 1891. These original slip couplings were entirely cast. Steel middle rings were first produced by Dresser in 1906 and the ends were stamped from steel in 1907.

The recessed screw coupling was not originated because of a demand within the industry, but because Henry Boyd of Providence, R. I., had a plant and no business during the depression following the Civil War. He searched around for an outlet and conceived the idea of recessed couplings thereby overcoming one of the main objections against wrought iron products of that day.

Mechanical Joints

Mechanical joints received an impetus in use due to investigations by A.G.A. committees started in 1927. However, the actual design and use in this country apparently commences in 1870 when Clark patented a joint and installed some in Elizabethtown, N. J., Consolidated Gas lines. Mechanical joints were also in use in England in 1870. S. R. Dresser patented a mechanical joint on May 1st, 1888. Between those dates and 1919 when the American Cast Iron Pipe Company developed the simplex prepared joint there was but little activity.

The possibilities of field welded joints was first called to the attention of the industry by the welding of all joints on the gas mains laid for the San Francisco Exposition in 1914. Oxy-acetylene welding was first invented by a Frenchman and used in France in 1901. It remained for the Prairie Pipe Line Company under Wagner to develop procedure control in 1919, this being one of the landmarks in oxy-acetylene welding.

The first extensive use of brazing on pipe lines was undertaken in California in 1924 as an "improved method of joining cast iron pipe." A small section of brazed line had been laid in Venice, Calif., with the collar type of joint in 1921. In 1924 four miles of 6" were laid with brazed joints on Long Island, N. Y. In 1926 the V type of brazed joint was designed and was soon followed by the shear V type.

The history of bell and spigot joints has often been expounded. It is interesting, however, to note that cement joints were being used in 1859. By 1874 we find a discussion by James Walker at a meeting of the American Gas Light Association of "the comparative value of cement and leaden joints." In 1909 we find Hole of England stating that in his opinion one of the outstanding recent developments was the development of lead wool for joints, first used in this country in 1905.

Origin of High Pressure

The origination of high pressure transmission and distribution systems is not clear in the records, due to locally devised innovations being used for the control of pressures. On August 1st, 1872, a 24" natural gas line of cast iron pipe was completed from Newtown well to Titusville, Pa., being a high pressure line but depending on well pressure rather than compressors. In England in 1875 a system was in operation carrying pressures up to 2 lbs. using compressors and manufactured gas. In 1899 Frederick H. Shelton, a pioneer in high pressure distribution, directed the construction and operation of a high pressure main from the manufacturing plant at Riverton to Morristown and Riverside, N. J. In 1902, the late Col. Anthony R. Kuser approved and constructed a 12" high pressure main from Camden to Trenton, N. J., a distance of 33 miles. Much doubt as to its practicality was expressed and failure predicted, but the Colonel witnessed its operation for over 25 years and in addition by 1905 a continuous line was in operation from Camden to Raritan, a distance of 90 miles, which long held the record for the high pressure transmission of manufactured gas.

Possibly the first manufactured gas high pressure transmission line was installed under San Francisco Bay between Oakland and Alameda in 1885 and carried 10 lbs. pressure.

In 1898 an Ingersoll Rand catalog mentions, "one novel application of Ingersoll-Sergeant piston inlet air compressor used in the oil fields near Fostoria, Ohio," for compressing natural gas.

In 1902 the Western United Company placed in operation a high pressure line from Aurora to Geneva, Batavia and St. Charles, Ill. Denver was one of the first large cities to have a medium pressure system.

In 1903 real foresight was shown by Henry L. Doherty when he said, "If I have $500,000 to spend on new mains I don't want to confine myself to the use of cast iron mains if I must curtail my profits $10,000 per year for the sake of abiding by a tradition."

High pressure required the use of individual regulators in each house. Apparently there were many home made affairs before 1893 when we find a patent applied for on a house regulator.

High pressure holders are of comparatively recent use. Tank types of high pressure holders have been in use since the early part of the century. The first Hortonsphere for use on gas was completed in October, 1927, for the Central Arizona Power and Light Company at Phoenix, Ariz., being 56' 6" in diameter and designed for 50 lbs. pressure. The first all-welded Hortonsphere was completed in January, 1933, for the St. Louis County Gas Co. at Shrewsbury, Mo., being 45' in diameter and designed for 50 lbs. pressure.

Plug Valves and Cocks

There was but little development in valves during the last century, but high pressure transmission and distribution created a demand fulfilled by the Merco Nordstrom Valve Company, now part of the Pittsburgh Equitable Company, with the invention of pressure lubricated plug valves and cocks. The first MN valves were used commercially at Pachuca and El Oro, Mexico, for the handling of slimes, cyanide and compressed air in the latter part of 1915. They were 1½" to 8" in size and handled solutions at pressures up to 50 lbs., and air up to 125 lbs. For their first use on gas we again go to California where, in 1919, the Pacific Gas & Electric Company used sizes from 1½" to 3" on pressures up to 35 lbs. In 1919 the first 12" round opening plug valves were constructed and the first Venturi type in 1925. Curb cocks of this type were not brought out commercially until 1926.

(Continued on page 155)

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Attempts to Imitate
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1. **GAS METERS** for domestic and large capacity service. Stop revenue losses through accurate measurement of all gas consumption.

2. **TELEMCO SYSTEM**—Remote control and indicating devices for transmitting volume and pressure information throughout the transmission and distribution system.

3. **ALEMCO CHARTS**—Moisture-proof, increase revenue through greater accuracy in orifice meter recording.

4. **EMCO-McGAUGHY INTEGRATORS** mechanically calculate orifice meter charts quickly, accurately and economically.

5. **BELL JOINT CLAMPS** stop gas losses at joints of existing cast iron bell and spigot pipe.

6. **EMCOLOADERS** reduce gas loss by automatically adjusting distribution pressure in proportion to demands.

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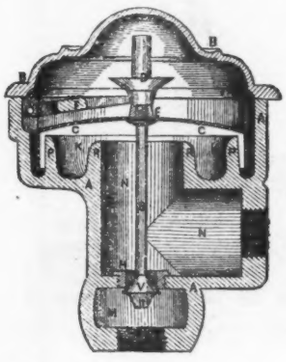
Development of Regulators and Pressure Regulation

By C. H. WARING

Engineer, Kansas City Gas Company

THE subject of regulators and pressure regulation is one that has had the attention of distribution engineers since gas was first made. There is no definite information as to who invented the regulator. Samuel Crossley was granted a patent in 1825. Other early inventors who are credited with developing regulators are Clegg, Braddock, Key and Wright. Although we have no description of these first regulators, we can assume that they were far different from those of today with their ability to handle gas at high pressure and large volume. The gas engineer of that date did not have the complex problems of distribution to solve as has the present day engineer.



Cooper's Gas Regulator, 1859, for regulating supply of gas to burner.

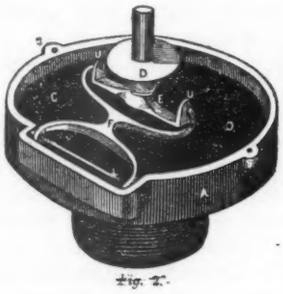


Fig. 2.

Gas, in 1825, was used only for lighting. In fact, this was its only use up to the fifties.

In those early days there was no need for pressure regulation except to control the pressure at the outlet of the holder. As cities and distribution systems grew, outlying holders were erected, but the practice of low pressure distribution was followed until about 1900.

The *American Gas Journal* for November 2, 1885, had this to say. "In the early history of gas lighting, the want of a governor to regulate pressure was soon felt. The same form of governor, so far as bell (or holder) is concerned, is now in general use; but varied methods have been devised to better govern the flow of gas, as in the cone, parabola and other forms of valves."

"The pressure given by any bell or holder depends upon its own weight, with the addition of cone, parabola, or other valves with their connecting rods. If their united weight is found too heavy for the area of same to produce the desired pressure, then a float or counterpoise is used, so as to bring the pressure to the lightest used—namely, day pressure," and farther along in the article, "But, unfortunately, it can be said that by far too many small gas works use no governors, but depend entirely upon opening and closing the street main valve."

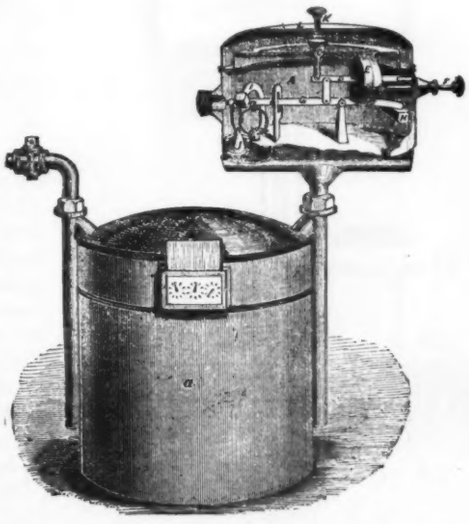
Again, in this article, Braddock is credited with designing a governor "causing the gas to pass downward through the opening between the cone and its seat, and also causing inlet pressure to act on an equal area on the under side of the bell, so as to bring about, as nearly as possible, the effect of a balanced valve."

This article closes with a statement of R. Mitchell, of Edinburgh, Scotland, who said, "I hold that to have one-tenth of an inch more pressure on your street mains, than is actually necessary to meet the requirements of your consumers, is wasteful and wrong." You will note that this gentleman was from Scotland.

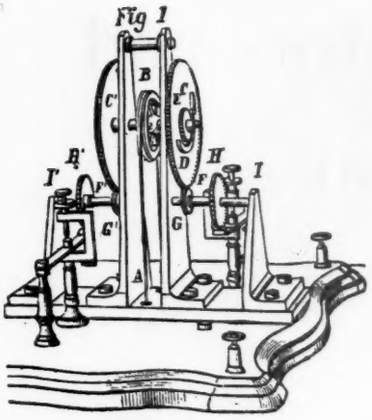
The descriptions above given were of governors in general use forty-nine years ago.

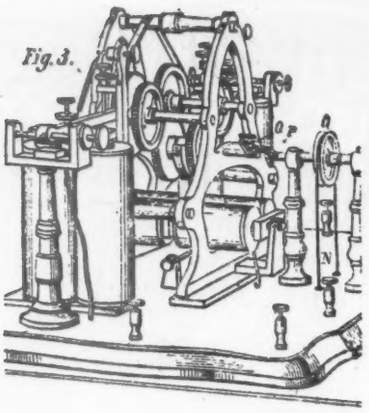
With the extension of natural gas service and the increased use of gas in homes and industries, the need for better regulation was created. No longer would regulators, capable only of handling low pressures and small volumes, do. Neither could they depend on a regulator that used water for increasing or decreasing the pressure. Some time between 1885 and 1900, the balanced valve, diaphragmed regulator came into use. This type, with modification and improvements, is in general use today.

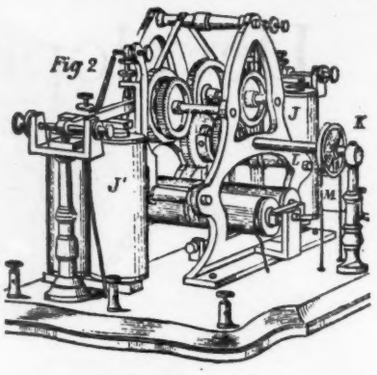
The introduction of natural gas with its high pressures, into the many cities and towns of this country, has had much to do in influencing the design of distribution systems. This influence has extended to those companies supplying manufactured gas. During the past twenty years, many of these companies have modified their distribution systems and are now delivering gas long distances through high pressure mains.

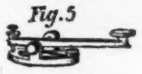


Begg's Gas Regulator attached to the meter. Marketed in 1868.









Munzinger's Electric Gas Governor and Pressure Regulator, 1873.

Fig. 1—Electric contact former. Fig. 2—Instrument in works. Fig. 3—Instrument for indicating degree of pressure in mains. Fig. 4—Dial plate. Fig. 5—Key

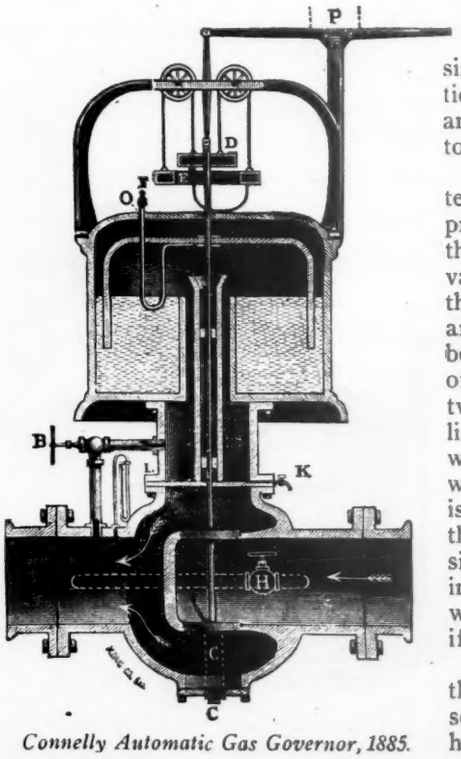
One of the generally accepted designs is known as the belt line system, gas at pounds pressure is carried around the city. At suitable points, governor stations are installed which feed into the low pressure mains. This system has been found to be the most economical to install, especially in those cities changing from manufactured to natural gas. There are modifications of this system, such as the semi-high pressure. In this, all mains carry gas at pounds pressure. This design compels the use of governors on each house service.

At the time belt line systems came into use, many companies built their governor stations above ground. This design, while having many points in its favor, was expensive, as it compelled the purchase of real estate. It was not always possible to acquire this ground at points that best fitted into the system, for the reason of surroundings, either residential or commercial. In later years, many companies have installed their governors in concrete pits under the parkway.

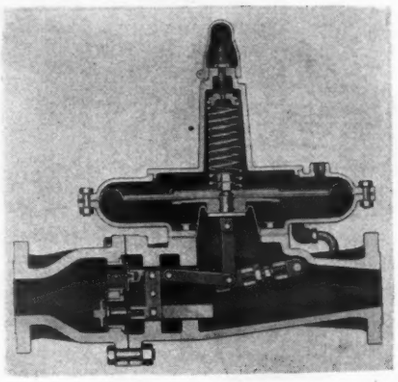
There are many ideas used in designing a governor station. Some engineers install two governors in each station; one set at a slightly higher pressure than the other. Some use single governor settings with a bypass. Some prefer few stations with larger governors, others many stations with smaller mains and governors. Whatever design is used, suitable relief valves or oil seals must be installed of sufficient size to prevent excessive accumulation of pressures at the outlet, if for any reason the governor should fail to function.

One problem develops during winter months when an excessive cut in pressure is made in one step, that is the danger of ice forming on the valves, due to the rapid expansion of the gas. To overcome this, stations are heated. In some cases, it may be necessary to raise the temperature of the flowing gas. This is done in two ways; one is to surround the line, before it enters the governor with a jacket, through which hot water is circulated, another method is to circulate hot flue gases around the pipe. The former method is desirable. The hot water boiler can be installed outside the station. In this way, there is less likelihood of fire if leaks develop within the station.

Governors are now constructed so that ready access to the valves and seats may be had through suitable hand holes. This is a great advance over the older styles which required a complete taking apart, if any work within the governor was necessary. There are governors now available which allow the substitution of different sized valves in the case without removing it from the line. This improvement makes it possible to install the proper valve area in the governor to carry the load. The size of governors should be determined by the demand, not by the size of the outlet line. It may be possible to install a 3-inch valve in a 6-inch line and have ample capacity. Proper sized regulators will give much better regulation.



Connelly Automatic Gas Governor, 1885.



A New Reynolds Double Balanced Valve Toggle Type Regulator.

One of the quotations given above notes that some of the earlier companies used no regulators but depended on the opening or closing of the street main valve. This practice has been followed in some cities up to a much later date, perhaps, not from their holder stations, but from their regulator stations. Increased demand during certain hours in the

(Continued on page 97)

The story of the Gas Industry during the past 75 years has been one of Advance.

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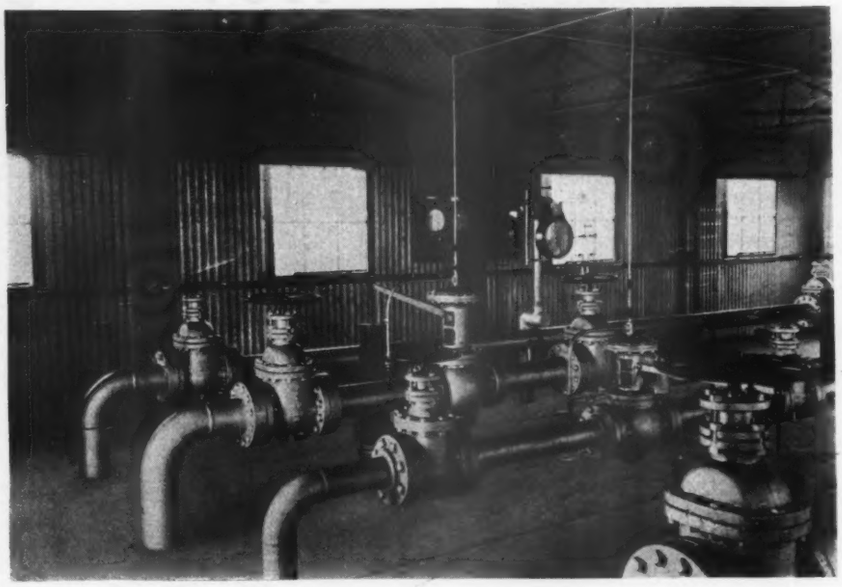
APPALACHIAN COALS, INC.

TRANSPORTATION BUILDING, CINCINNATI, OHIO

Development of Regulators and Pressure Regulation

(Continued from page 94)

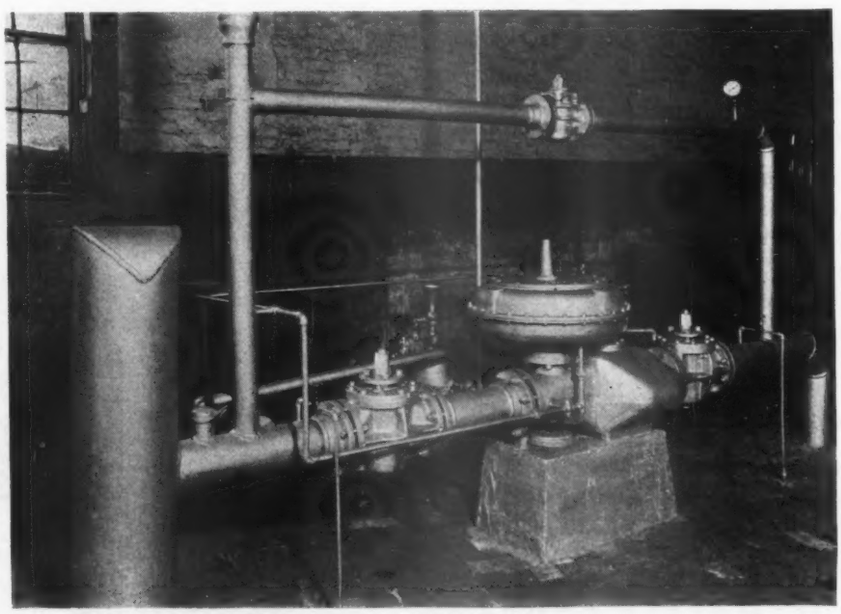


Chaplin-Fulton Installation, 1932

day may cause excessive drop in pressure at some distance from the station. To overcome this, automatic loaders may be attached to existing governors. This attachment increases the pressure during peak hours and reduces to normal after the peak.

Another method, and one that will accomplish the same results, is to connect the governor pressure pipe to a main some distance from the station. This takes advantage of the loss in pressure between the station and the point of connection of the pressure pipe thus raising the pressure at the station until the load has dropped off when the pressure again returns to normal.

Expanding use of gas in homes and factories and improvement in designs of appliances with all their automatic features calls for closer regulation of gas pressure. It may be an ice box consuming one or two feet per hour or a power plant, with several hundred thousand hourly demand. Whatever the requirements, manufacturers have provided us with a dependable regulator.



Emco Low Pressure Balanced Valve Regulator and Nordstrom Lubricated Plug Valves Used in Connection with Oil Fogging Apparatus.

Utilization of Propane and Butane

(Continued from page 72)

Since its erection in 1928, this installation has proven very satisfactory. No difficulties in appliance operation have been experienced and during the plant's operation excellent results have been obtained. The cost of this installation was under $50,000 and it provides a gas reserve equivalent to 13,900 M cu. ft. of natural gas.

Cracking or reforming butane or propane offers an additional means of meeting peak loads. Inasmuch as the calorific value, specific gravities and chemical composition of the gas obtained in this manner can be varied within a wide range, it possesses a high degree of flexibility.

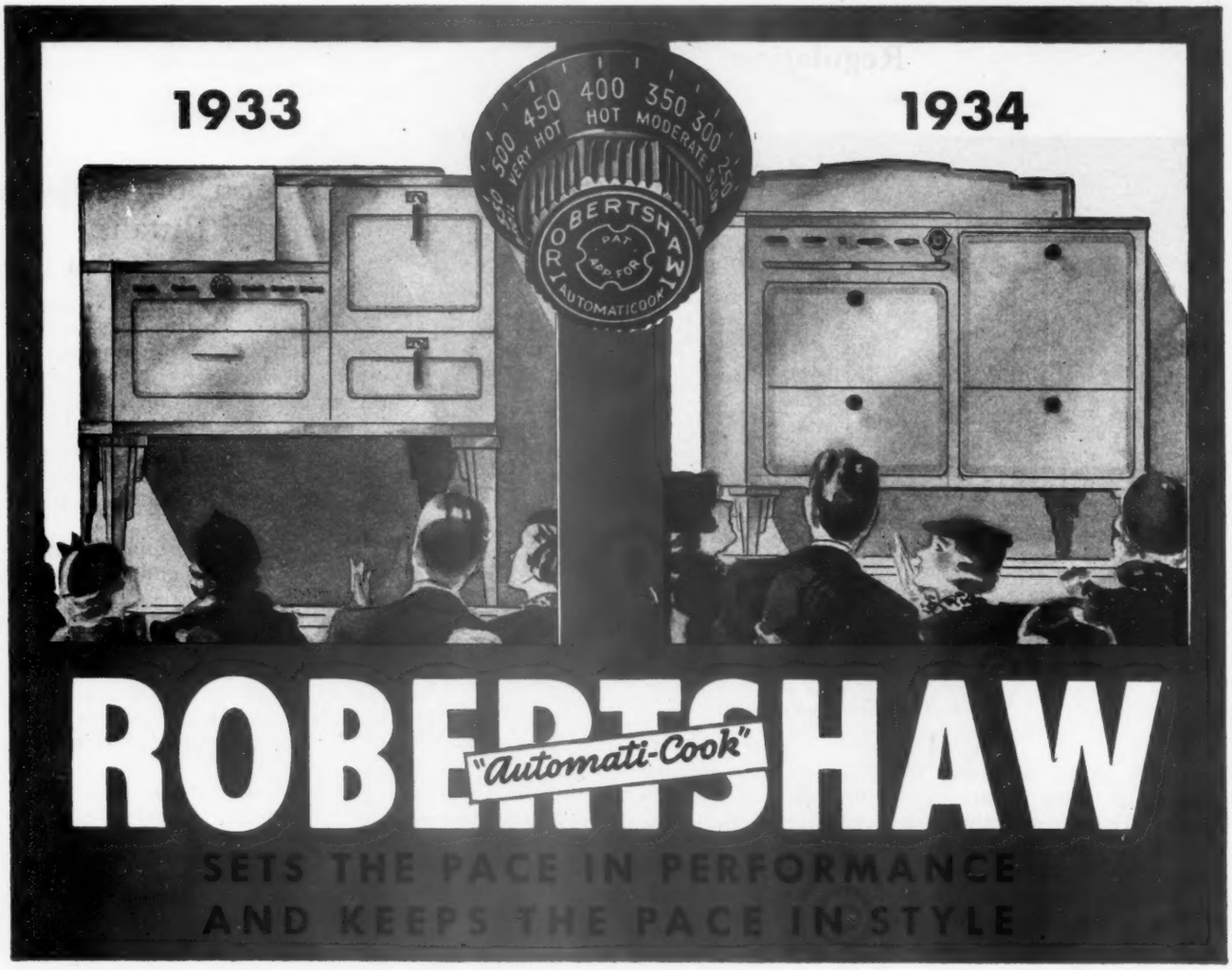
The processes can be divided into three classes:

(a) Straight cracking.
(b) Reforming through incandescent bed of coke.
(c) Continuous catalytic processes. (Usually combined cracking and water gas reaction, employing steam.)

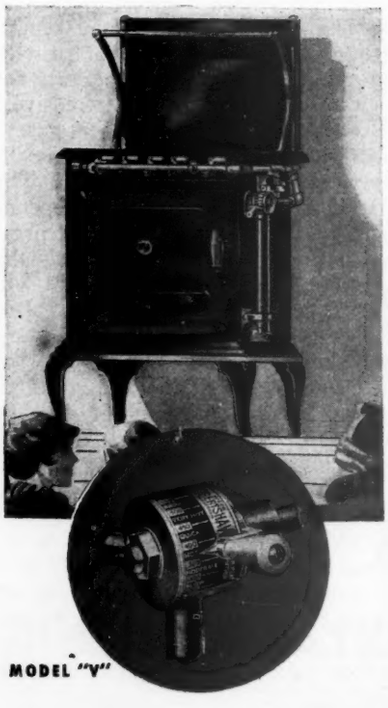
Uninterrupted service is one of the prime requisites of good gas service. The probability of a break in transmission lines is, while remote, ever present.

The supply of gas required in such a case is in reality a special peak load problem. Where peak load equipment is installed the cost of providing additional capacity to care for such an emergency is not excessive.

To store sufficient finished gas to meet such a demand is apt to result in excessive investment costs. The cost of gas storage will vary, depending upon whether low or high pressure storage is used, as well as the size of holders. The cost per M will range from $60.00 to $120.00. Butane and propane, on account of their high thermal value and the fact that they can be stored in a liquid state, occupy but 1/136th (in the case of butane) of the volume that the thermal equivalent of natural gas of 1100 B.t.u. at 75 lbs. gauge would occupy. Consequently, the cost of storage for the butane equivalent of 1 M cu. ft. of natural gas is approximately $.90 as compared to the figures given above. It is, therefore, quite apparent that for reserve standby use, butane and propane offer distinct economies.



1920



MODEL "V"

MAKING GAS the perfect cooking fuel, means that the oven must be under perfect control.

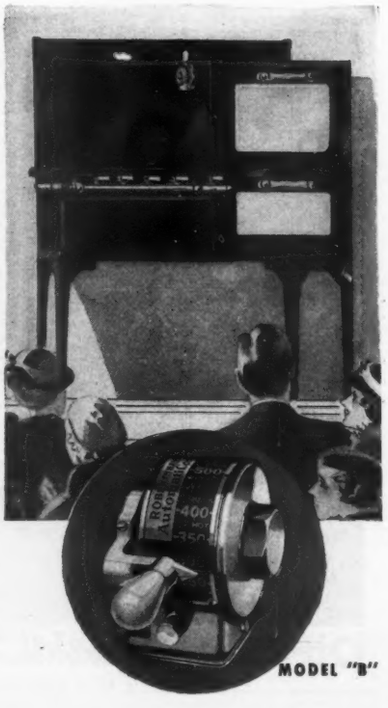
Robertshaw realized that, fourteen years ago in the creation of the first Robertshaw automatic oven control for gas ranges.

Ever since that time, the Robertshaw has made consistent progress in both design and performance. Nearly two million women now depend on the Robertshaw. The current Robertshaw advertisements in The Saturday Evening Post are carrying the Robertshaw story into nearly three million above-average homes.

The Robertshaw is a real force in gas range salesmanship—be sure you tie up with the Robertshaw campaign.

ROBERTSHAW
THERMOSTAT COMPANY
Youngwood, Pa.

1926



MODEL "B"

History of Industrial Gas Utilization

By J. F. QUINN

Supervisor, Industrial Gas Sales, The Brooklyn Union Gas Company

The Use of Gas for Industrial Purposes Is Growing Apace.

THE word "gas" appears to have been used first about 1609 by a Flemish chemist, Van-Helmont, who probably derived it from the Flemish word meaning spirit. The use of combustible gas, however, was known long before this. The Chinese as early as 900 AD, piped natural gas through bamboo tubes and used it for lighting. The first record of coal gas is in the writings of John Clayton, a Yorkshire Minister, who between 1660 and 1670 distilled coal. He described the gas as a "black oil" obtained by heating coal but made no practical use of his discovery.

It remained for William Murdock, a Scotch Engineer, to make practical applications of these discoveries. In 1792, he distilled coal in an iron retort, using some 70 feet of copper and tin pipes, lighted his home in in Cornwall with coal gas. He also, lighted a Soho Foundry (where the first steam engine was developed) with gas.

The first patent for the making of gas was obtained by Philippe Lebon of Paris in 1799. All of these men were scientists and engineers.

The first promoter in the gas business was Frederick Albert Windsor, a German. He learned what he could from Philippe Lebon, then went to London in 1804 and obtained the first English patents for the manufacture of gas. By his lectures and demonstrations, he did much to overcome public prejudice. In 1807, he lighted Pall Mall in London with coal gas. This was the first successful public street lighting. The charter for the first gas company known as the London and Westminster Gas Light & Coke Company was granted to Windsor, and others in 1812. Therefore, Windsor was the man with the first vision of the future of the gas industry.

There are claims of early experiments with gas lighting in Philadelphia in 1796, and in Richmond in 1803. It is generally conceded, however, that gas was really introduced in this country by David Melville, who lighted his home in Newport, R. I., with gas in 1806. The first gas company in the U. S. was organized in Baltimore, Md., by Rembrandt Peale in 1816.

Natural Gas in Industry

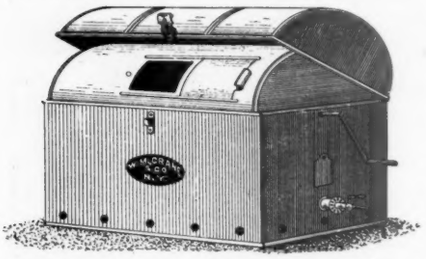
Natural gas was used in industry far beyond the dim years of first authentic history, and so no date can be set for its introduction as an industrial fuel. To that venerable race, the Chinese, must go the credit for its first industrial utilization along with their discovery of gunpowder and the art of cooking food. How they found it no one knows, but they had been using it for centuries when a missionary, in 1833, told how they brought it to their salt works through bamboo pipes, and how they tipped the burners under their salt solution evaporators with earthenware to prevent their burning off.

The ancient Persians and Greeks worshipped the ignited seepings of natural gas as a god of fire. More recent people, even our own, as late as 1821, beheld it first in awe, then as a curiosity, and later as a nuisance. Its first production in commercial quantities came about purely as an accident when gas instead of expected oil was struck on several occasions. It was considered as a necessary evil encountered in oil drilling, except in some cases where it was turned into steam lines when its pressure was higher than the steam pressure the field boilers could develop.

In 1820, a salt works near Pittsburgh, while drilling for salt water, struck natural gas which, igniting accidentally, burned down the plant. The well was plugged—a failure. It's all in the point of view; today it's a disappointment when gas drillers strike salt water.

Not only was the discovery of na-

tural gas both accidental and incidental; it was also premature. It came before there were any known means of capturing and retaining its gigantic force. No fittings or connections were available for holding back "rock" pressures that sometimes exceeded a thousand pounds per square inch, so that, when a "gasser" of such a magnitude was turned in, this precious commodity of nature was allowed to blow off into the atmosphere until the pressure was relieved to a controllable amount.



Vulcan Gas-fired Coffee Roaster, 1892—a Modest Beginning.

The first industrial use of natural gas came in the early seventies when several steel companies began drilling for gas on their own account and piping it to their own plants. It was used for wrought iron puddling, steel heating, steam generation, and for melting glass. The crudest possible method of application was in vogue. The gas was merely introduced from the plain pipe ends, with little or no thought to the control of air. Because there were still no means for controlling pressures, the surplus was burned into the air over week end shut-down periods, and it is no wonder that furnaces were kept hot continuously and that steam boilers were allowed to blow off excess steam pressure instead of shutting off the gas.

This appalling squandering of a valuable natural resource not only resulted in rapid depletion of nearby pools of natural gas, but led to wasteful habits among industrial operators, that prevailed for years, and is still encountered at times.

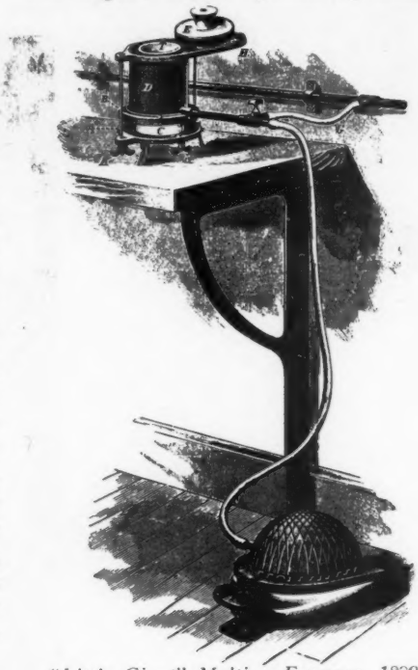
Some gas producing companies were formed and immediate demands were made upon them, not only by the industrial plants whose own supply was becoming depleted, but by others who were anxious to burn gas because of its economy and ease of application. Large gas measurement devices being unknown, gas companies supplied those plants on a flat monthly charge based on the number and size of outlets. This method of payment obviously induced a continuation of wasteful utilization resulting in a rapid depletion of gas companies' holdings.

But here, necessity, under duress, gave birth to invention, and the gas meter and gas regulator came into use. Thus, an entirely new situation appeared. Industrial gas consumers found they could no longer burn gas needlessly and maintain economy. At the same time the surviving gas companies were rescued from bankruptcy.

About the beginning of 1900 the gas fields close to the industrial market began to show signs of depletion, which manifested itself in low pressures in cold weather. The well pressures were depended upon to send the gas to its destination and these pressures began to drop. Gas rates increased due to extra operating costs and gas companies began to advise—even to advertise the fact—that preparations should be made to enable the use of some standby fuel. Gas utilities in some cases during cold weather were forced to curtail service to industrial plants in order to maintain domestic supply. Hence, industrial consumers rapidly lost faith in natural gas stability and the result was a serious loss of this class of business.

Meanwhile, natural gas producers began widening their circle of drilling operations to include pools farther removed from their markets. Transmission lines were increased gradually until the present day setup of transmission lines hundreds of miles in length, with compressing stations at strategic points both to draw gas from widely distributed fields and to send it through the large transmission arteries to distant markets, was evolved.

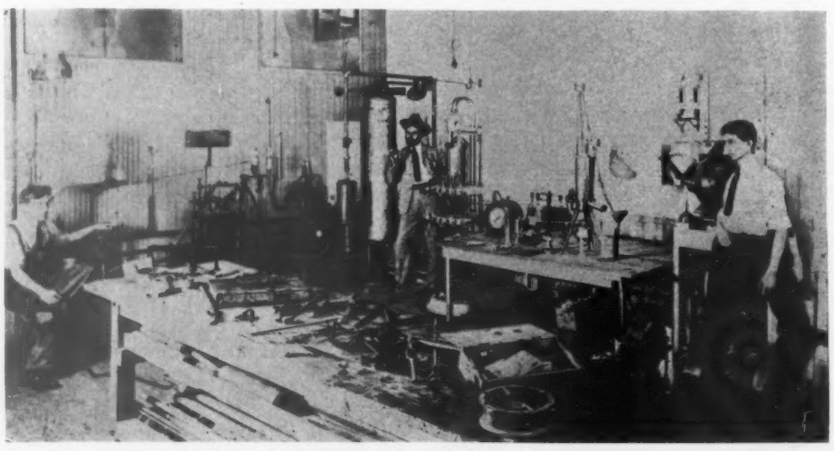
Owners of gas holdings in many other sections of the United States, who had deemed their holdings useless because of their distance from industrial and thickly populated centers, suddenly realized the opportunity awaiting them, and large high pressure transmission lines began shooting cross-country in all directions from the largest known pools. In addition, large scale prospecting was begun, which opened up many other previously unsuspected fields.



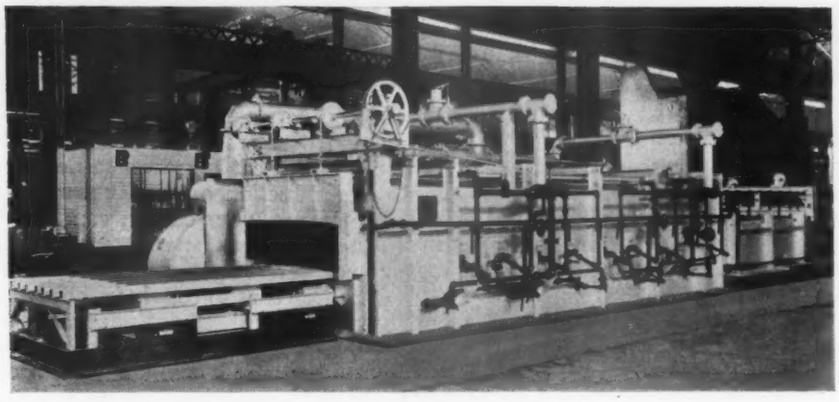
"Little Giant" Melting Furnace, 1879.

With equal suddenness, the entire aspect of the gas industry was changed. Gas companies found themselves possessed of almost unimaginable reserves of natural gas, but with a market that had turned its back. The reputation of instability had taken deadly hold. Moreover, natural gas rates were increased due to the higher operating costs of long distance transmission.

The natural gas industry found itself in a completely reversed position. Instead of industrial fuel consumers coming to gas companies for service, the latter found they had to go out and *sell* their service—a thing heretofore unheard of. Something new—industrial gas sales depart-



Original Denver Testing Laboratory Developed by H. L. Doherty in the early Nineteen Hundreds.



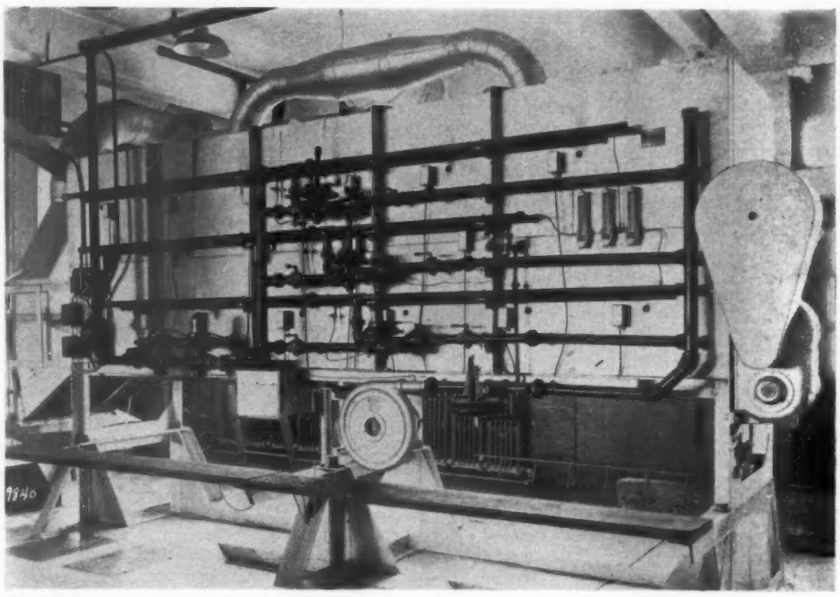
Continuous Sheet Normalizing furnace. Recording control instrument room in left background. Natural gas-fueled.

ments—were beginning to appear in gas company organizations.

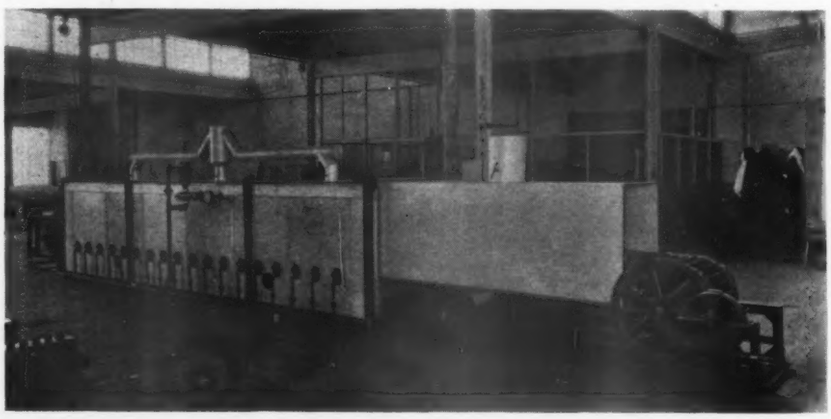
Simultaneously new gas burning appliances, designed to produce high combustion efficiencies to offset increased cost of gas, began to spring up like mushrooms. Companies were organized solely for the manufacture of industrial gas burners and heating appliances.

Gas companies now have come to realize that they possess something more than a mere fuel. Researches have proven that entirely new industrial processes could be adopted using gas fuel, where, an account of its adaptability to controlled temperatures in all ranges, and its chemical nature, undreamed of short cuts and economies were possible in the keen competition of our ultra-rapid scientific growth. Thus gas has become, instead of a mere fuel, an entirely new tool, combining heat and chemistry to assist a reborn metallurgy, both ferrous and non-ferrous, and simplifying and improving heating operations in every other industrial branch.

The advent of lightweight refractories, new and improved gas burning equipment, and developments in the science of heat applications have helped to place gas above the competitive stratum of cruder fuels. Industrial rehabilitation holds a golden future for an awakened and rejuvenated natural gas industry.



Barber Continuous Type Peanut Roaster equipped with Eclipse Fuel Engineering Co. burner equipment and automatic control by the use of Partlow temperature control equipment.



Gehnrich direct heated Tempering Oven equipped with Robertshaw temperature control.

The earliest record of the gas engine was that of the (Lenoir) invention in the year of 1863-1864. Gas engines for developing power began to be used very extensively in this early period of the gas industry. But, shortly after the above date, an important departure in gas utilization took place.

In 1869 George Machlet arrived in this country and established himself in the same class of business at which he worked in Germany. This had to do with the supplying of gauges, saws and other equipment to manufacturing jewelers. The high grade of workmanship of George Machlet attracted the attention of E. P. Reichhelm, who at that time was with a jewelry supply house. Mr. Machlet revealed the fact that he believed he had a system of burning gas which would be far superior to the Bunsen flame then being used. Mr. Reichhelm realized the possibility of the positive pressure air system advocated by Mr. Machlet and proposed that Mr. Machlet build a working model. Hence, the birth of industrial gas equipment and the eventual result was the "first little giant melter."

But, many difficulties had to be overcome and many disappointments forgotten in their efforts to introduce this new development; however, it gradually gained a foot-hold and was adopted by large jewelers where their experience taught them that it was not a flame burning some three or four feet out of a small furnace which melted the alloy but a correct mixture of gas and air burning

where it was intended; that is, under and around the crucible.

As a result of the above, the American Gas Furnace Company of Elizabeth, N. J., was incorporated under that name January 1, 1887 under the laws of New Jersey. From this time on, the growth of the company was rather rapid. Equipment was first supplied to the U. S. Assay Office for their work which lead to the adoption of furnace melters and assay muffle furnaces by the Philadelphia mint and then by many others of the U. S. Mints.

Wide Variety of Equipment Built

With the passing of the years this company built, in addition to melter and muffle furnaces, boiling out furnaces, blow pipes, burners, scorifying melters, assay furnaces, brazing equipment, blowers, etc. More and varied equipment was supplied for industries fabricating parts from iron and steel. Oven furnaces were built to order, so that today more than 100 different sizes and styles of oven furnaces can be had. Forges, soft metal melting furnaces, lead hardening furnaces, cyanide hardening furnaces, carburizing machines and heating machines in a great variety of sizes and styles were built.

Developments along other lines have been more or less parallel. The roller conveyor heating machine was built in 1901 and was very clearly the forerunner of the present day roller conveyor heating machine. In this machine, the flexible conveyor may be used where desired for the heat treatment of small parts.

Mr. Machlet of the American Gas Furnace Company has done considerable pioneering work in the nitriding of steel and again very recently he has developed a process known as "Nicarbe." It is a combination of nitriding and carburizing and will be beneficial in the heat treating of steel and particularly in the hardware industry. In addition to it giving a hard surface it is hoped that it will be rust resisting.

Standard industrial gas equipment dates back to the early 1900's with H. L. Doherty improved gas burners and appliances in the testing laboratory of the Denver Gas Company. The outgrowth of this activity was the organization of the Improved Appliance Company in Denver, for the manufacture of this equipment. This company later moved to Brooklyn, N. Y., and joined with the Combustion Utilities Corporation. Some of the equipment manufactured by them, such as the tile burners, was added to the standard line. When the Surface Combustion Company was added to the group the standard line was further augmented by the Surface Combustion standard furnaces, some of which had been built by the Standard Fuel Engineering Company for the Surface Combustion Company using Surface Combustion burner equipment. When the factories were consolidated in Toledo, these furnaces were redesigned and are now all manufactured by the Surface Combustion Company.

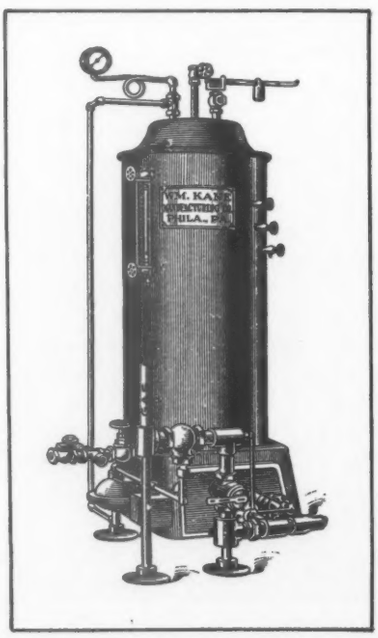
From this time on, high speed steel hardening furnaces, potato chip furnaces, varnish fires, direct gas fired air heaters were manufactured, and up to this period the direct gas-fired air heater was of the pull through type, i.e., operated with fan at the heater outlet. The new Surface Combustion heater operates with a fan at the inlet; a distinct improvement in that the fan handles much cooler air than at the heater outlet. Consequently, it may be smaller and requires less power.

In 1931 the development of diffusion combustion and its application to forging took place.

On or about 1911 the first work on the scientific combustion of gas in the high pressure field was started. This led to a train of events which resulted in the creation of the Surface Combustion Company; the first of the so-called appliance manufacturers to deal with high temperature apparatus.

Gas Fired Steam Boilers

William Kane was a pioneer in bringing to the attention of the public what could be done with gas fuel both in generating steam and furnishing hot water. His first boiler for generating steam with gas fuel was exhibited in 1896 and his first patent was allowed in March 14, 1899. His long experience in connection with the gas business convinced him that there was a field for the introduction of gas fuel to generate steam under certain conditions. In the beginning he was discouraged by managers of gas companies and it took nine years to convince them that it was feasible! Now industrial gas fired steam boilers are used extensively throughout the United States, Canada, South America and West Indies.



Kane Boiler, 1908.

Vigorous Boiler Growth

The Kane boiler of today differs greatly in appearance from the early 1896 model. However, the internal arrangement of the boiler proper is still the same. The Kane boiler embodies the vertical fire tube type of construction. It is unique in that the shell acts as heating surface as well as the tubes. Thus, every inch of the boiler is a steam maker. Originally a fulcrum type of gas control was used on all Kane gas fired boilers, but since 1927 boilers have been equipped with patented double diaphragm gas control such as are used on the "Ofeldt" boilers. Also, a combination water regulator and low water gas cut-off has been included as standard equipment on all boilers from 7 to 30 H.P. inclusive.

In 1922 the business of the Kane Manufacturing Company was taken over by Mr. Frederick K. Mears, and was carried on under their leadership, and in 1925 the Ofeldt Gas Fired Boiler Company of Nyack, N. Y. (formerly F. W. Ofeldt & Sons) was acquired by the William Kane Manufacturing Company, at which time the name was changed to Mears-Kane-Ofeldt, Inc. There has been no marked change in the construction or outward appearance of the Ofeldt boiler. The difference between this type and the Kane is that the Ofeldt boiler is of the water tube type, and a rapid steamer. Steam pressure is raised within four minutes after lighting the burner and this type of boiler is especially adapted for light steaming application and intermittent work.

In 1929 Mears-Kane-Ofeldt Company developed an automatic boiler feed unit which economically and automatically feeds water to boilers. This unit not only pumps feed water against high boiler pressure and maintains constant water level, but it also returns condensation to the boiler to supply make-up water as required. This unit is electrically

operated and automatically controlled, thus assuring a constant water level without fluctuation of steam pressure.

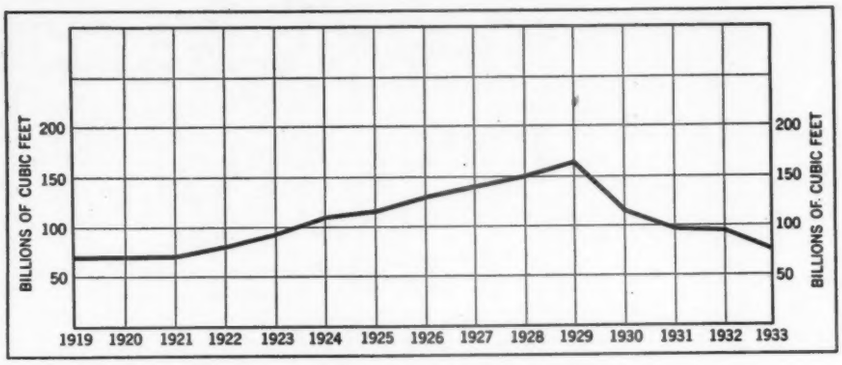


Chart 1—Industrial Gas Sales: Manufactured Gas

Up to about 1895 little or no attention was given to the design of ovens best adapted for the japanning processes, i. e., drying finishes, which evaporate in inflammable solvent. The old type of brick oven with coal fired salamander in one corner was considered good enough and probably was, what with the limited production and slow baking then in vogue.

The Gehnrich Oven Company, pioneers in the application of gas to industrial oven processes, developed features of construction which revolutionized baking methods and today are universally accepted as standards. They were the first to adapt insulated sectional steel panel type oven construction, indirect method of gas heating, fresh air circulation and floor exhaust systems. The indirect gas radiator system improved the oven construction by providing a clean heating source and eliminated the high temperature radiance inherent in direct burners. With an indirect system it was found possible to bake light color enamels without discoloration. This indirect system has been improved periodically, until today it incorporates the recuperative heating principle, heating the intake fresh air by the outgoing gas thereby effecting more efficient transfer of available fuel heat to baking space and also providing a means for adjusting the distribution of temperature for uniformity in the top and floor of the oven. From the standpoint of safety, the indirect radiator design improved conditions by removing the flame from the baking space.

About 1910 the ovens were also equipped with floor exhaust; recognizing that some of the solvent vapors were heavier than air and had to be exhausted at the floor level. It was not, however, until the high speed production era, following the World War period, that the Mutual Factory Insurance Company made extensive research and determined that the real key to safety in the japanning processes was the dilution of the solvent vapors to a concentration below the explosive limit, and established that, "from the explosion standpoint, it makes no essential difference whether the oven is heated by gas, fuel oil, electricity or other methods"—internal or external. This put at rest the claims of any competing heating medium. Today this type of indirect radiator gas heated oven has the complete approval of the underwriters for japanning. It is equipped with positive exhaust fan and " Gehnrich interlocking safety equipment," which not only insures adequate ventilation to keep the solvent concentration below the explosive limits, but interlocks the fuel supply so that heat is available only after adequate ventilation has been established. In the early days, the gas fuel engineer had to grope considerably in the dark as to whether it would be advantageous to put the product in direct fired atmospheres at low temperatures. These fears have all been eliminated, for today it is a known fact that, for various reasons, a great many of the low temperature processes must be fired by the indirect heating method. For a great number of these processes, the indirect air heater which was developed by the Gehnrich Oven Company is used. In fact, the ovens and air heaters produced by this manufacturer are used extensively in various manufacturing plants for the processing of japanning, enamelling, core baking, baking of armatures, electrical insulating, varnishes, drying of chemicals, low temperature heat treating, such as annealing of glass or aluminum and all manufacturing processes requiring temperatures up to 1000° F. Recently this indirect heated oven was introduced in the wire coating industry where substantial savings have been shown.

The early history of the Standard Gas Equipment Corporation with industrial gas development appears to have started about 1890. William M. Crane Company at that time connected with the Gibbons Superheating Company and later the Standard Gas Equipment Corporation obtained certain patents for hotel ranges, broilers and various other unique industrial gas appliances. It is interesting to mention the progress made, particularly in the hotel and restaurant field by this company.

Another of the pioneers was G. S. Blodgett Company, Inc., who in the early days built tray type ovens for the food, foundry and chemical industries using wood and solid fuel and later, as the result of research, converted and developed their ovens to burn gas.

It would hardly be fair to write this article without referring to some work done by the scientific instrument manufacturers who have lent considerable ingenuity in the developing of scientific instruments for automatic temperature and furnace atmosphere control. As early as 1899, the Robertshaw Thermostat Company developed a thermostat for hot water heaters. Considerable progress has been made from that time on, from the simple thermostat used in water heating or on coffee urns to temperature controllers on continuous conveyor type gas heated equipment.

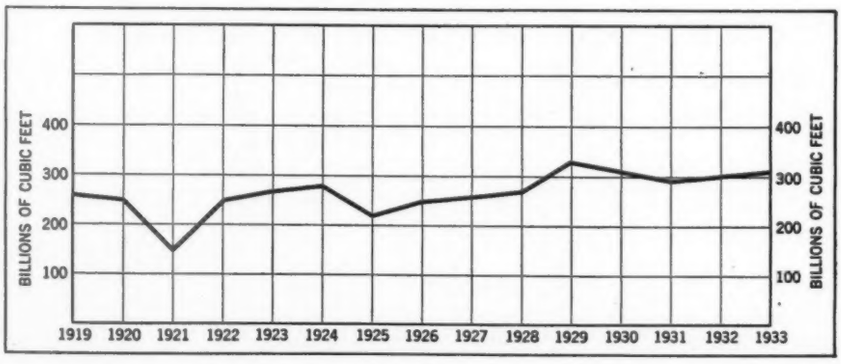


Chart 2—Industrial Gas Sales: Natural Gas

The history of early gas appliances and what they looked like or how well they served their purpose cannot be ascertained except by consulting some of the pioneer gas men. Usually the demand for an appliance to fill a given function was created by the early gas salesman, who after selling the customer on the idea had to further exercise his ingenuity and devise some means of accomplishing the desired result. If the device was successful, it was an easy matter to convince all the other merchants in the same locality of its desirability. Typical of this work was a book published in 1904 by James H. Walker of the Milwaukee Gas Light Company of Milwaukee, Wis. When one reads this book which was titled "Facts Relating to the use of Gas for Manufacturing Purposes," at this late date, he cannot help but give due credit to Mr. Walker for being at least fifteen to twenty years ahead of his time, for a number of his applications are accepted in practice today.

About 1908 most all of the appliances were of the atmospheric type using gas at low pressure and indirect air from the atmosphere. Between 1907 and 1910 came two distinct changes: First, two or more manufacturers of appliances placed their products at the disposal of the gas industry; second, the blast burner, using air and gas under pressure made its appearance. It was this latter burner which paved the way for the introduction of gas into a much wider field than it had enjoyed heretofore. Up to this time there was little or no attempt made to push gas into the high temperature field and conversely no appliances to assist in its invasion.

While the manufacturers of Industrial Gas equipment carried on early pioneering for the gas industry there were several large gas utility companies throughout the country who had to do considerable pioneering themselves, and as a result of their work the information was made known to manufacturers so that equipment could be properly designed, built and operated economically.

It is interesting to note that the United Gas Improvement Company, in Philadelphia, Pa., in 1911, sold 188,855,400 cubic feet of gas for the developing of power by gas engines.

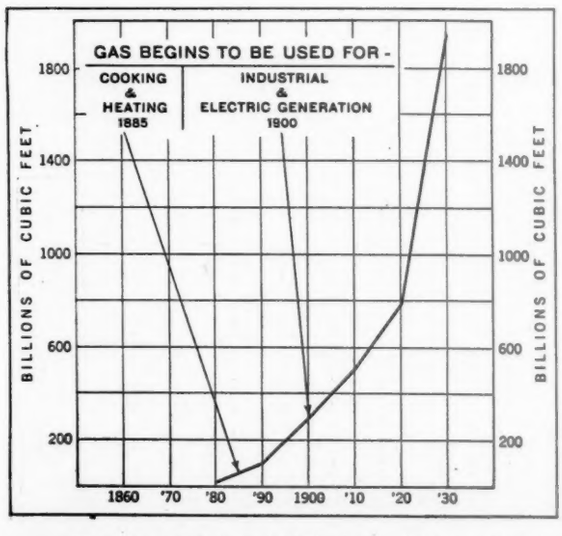


Chart 4--Growth of Natural Gas Sales in U. S.

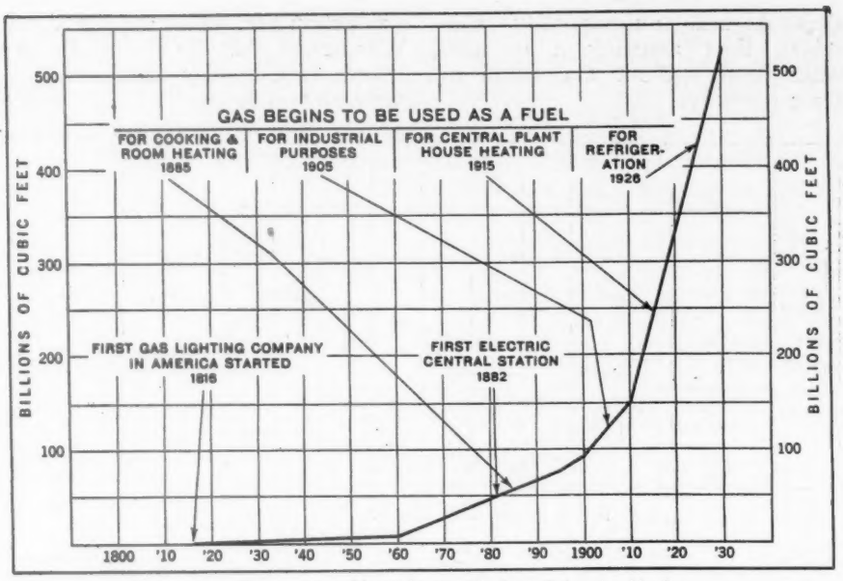

GAS BEGINS TO BE USED AS A FUEL
FOR COOKING & ROOM HEATING 1885
FOR INDUSTRIAL PURPOSES 1905
FOR CENTRAL PLANT HOUSE HEATING 1915
FOR REFRIGERATION 1926
FIRST GAS LIGHTING COMPANY IN AMERICA STARTED 1816
FIRST ELECTRIC CENTRAL STATION 1882
BILLIONS OF CUBIC FEET
500
400
300
200
100
1800 '10 '20 '30 '40 '50 '60 '70 '80 '90 1900 '10 '20 '30

Chart 3—Growth of Manufactured Gas Sales in U. S.

American Gas Association Statistics

It is rather unfortunate but industrial gas statistics until very recently had not been collected and co-ordinated.

Chart No. 1 indicates industrial gas sales in the manufactured gas industry from 1919-1933 inclusive. The apparent loss of industrial gas sales according to this chart in 1929 is not a true indication of gas sales in the manufactured gas industry. Following this period the world at large was confronted with a period of depression which affected industry and we must also, take into consideration that a considerable number of manufactured gas utilities, particularly in the Mid West, changed over from manufactured gas distribution to natural and mixed gas. This will be evidenced by a chart to follow.

Chart No. 2 indicates industrial gas sales in the natural gas industry. The loss from 1929-1931 is not so apparent. This qualifies my previous statement with reference to manufactured gas utilities changing over to natural gas. From that point on to 1933, the industrial gas sales are apparently on the increase. The gas utility is as good a barometer for business conditions throughout the country as I know of. From all indications the lowest ebb of the world's depression has been arrived at and we are now climbing the ladder once again. The future never looked brighter for industrial gas sales in both the manufactured and natural gas territories than it does today.

Chart No. 3 is an interesting graph, in that it shows the growth of the manufactured gas sales in the United States. It indicates that in or about 1816, gas was first used for lighting and apparently kept rather constant until about 1863 or during the Civil War. About 1882, they began to use it for central electric power generation. Again in 1885, cooking and room heating was added and the sales increased to a very large extent for the next ten years. In 1915, gas for house heating was accepted by the public at large in the manufactured gas industry which is evidenced by the increase in gas sales. A more recent development was in 1926, when refrigeration was added to the gas sales.

Chart No. 4 indicates the growth of the natural gas sales in the United States. Statistics do not go beyond

(Continued on page 142)

QUIGLEY PRODUCTS for the GAS PLANT

For Construction and Maintenance of Generating Sets; Inclined or Vertical Retorts, and Boiler Furnaces

HYTEMPITE

REG. U. S. PAT. OFF.

and Other Quigley Refractories

A Complete Line —affording a Selection of Materials to Meet Every Furnace Condition

No one refractory is a "cure-all." In determining the proper refractories and methods of installation for the various units of gas plant equipment, you can safely follow Quigley recommendations, BECAUSE:

(1) Complete Line . . . "a product to fit the job."

(2) Experience . . . 37 years in the furnace and refractories field.

(3) Quality . . . proven by performance in gas plants all over the world.

(4) Distribution . . . responsible stock carrying distributors in important industrial centers (see list below) to serve your regular or emergency requirements.

(5) Service . . . a corps of competent engineers—to advise personally with you.

QUIGLEY FIRE BRICK . . . high grade Missouri and New Jersey fire clay brick.

HYTEMPITE . . . the world's standard high temperature cement. Used by gas plants for nearly 20 years.

FYRE-MORTAR . . . a superior dry refractory cement.

Q-CHROME . . . neutral-base super-refractory cement.

MONO-LINE . . . the Quigley plastic fire brick.

CAST-REFRACT . . . castable refractory.

HEARTH-CRETE . . . a special chrome-base castable.

QUIGLEY REFRACTORY GUN . . . for furnace maintenance.

The Quigley Refractory Gun

Applies premixed plastic refractory materials for repairs and maintenance of refractory structures and surfaces. It shoots the mixed material at high velocity so that it will fill all crevices and will stick to a hot or cold wall or arch. A ruggedly built item of equipment PRESSURE FEED handles mixtures of the proper consistency for the job.

In Gas Plants, the Quigley Gun is used to—

Resurface and repair Retorts and Furnace walls

Repair Baffles, and Build new Baffles

Fill Cracks or Holes

Repair Coke Oven Jamb Joints

Gas and By-Product Coke Plants have used the Quigley Refractory Gun for years with great success and considerable saving in labor. Can also be used for applying other plastic mixtures such as Portland Cement and stucco if desired.

Operates by compressed air—pressure feed—no suction. Capacity 2 cubic feet of refractory mixture. Ask for bulletin and list of users.

THROUGHOUT THE PLANT—

for Protection of Structures and Equipment

QUIGLEY TRIPLE-A

ANTI-ACID-ALKA-QUA

AAA

REG. U. S. PAT. OFF.

PROTECTIVE COATINGS

There are definite reasons why TRIPLE-A Protective Coatings "*give superior protection against corrosion*"—and the most important of these is PENETRATION.

TRIPLE-A Coatings (Nos. 10, 20, and 44) have remarkable penetrating properties. They thoroughly impregnate and seal the pits and pores of the surface on which applied—keep out moisture, air, and corrosive fumes. TRIPLE-A Coatings are furthermore highly resistant to acids and alkalies, resist heat, and have many other distinctive advantages. *Records in many instances have shown TRIPLE-A to give two and three times the service given by the best grades of ordinary paints.*

Investigate the advantages of TRIPLE-A before you undertake your next painting job. Black, aluminum, and a series of beautiful colors. Why not send now for TRIPLE-A bulletins?

"LIFE INSURANCE FOR STEEL"

For Pipe Lines and Equipment

in and around the Gas Plant, Power Plant, and Auxiliaries..

Make all Threaded, Flange, Gasket, and Metal-to-Metal Joints LEAKPROOF

Q-SEAL

REG. U. S. PAT. OFF.—U. S. PAT. NO. 1,919,037

PLASTIC EXPANSIVE JOINT SEALING COMPOUND

"High-Pressure Steam, Oil, Acid, and Chemical Proof"

You'll find Q-SEAL better than other sealing compounds—and more economical, too. Double expansion (pigment and vehicle) insures TIGHT JOINTS. It is a natural preserver of metal, withstands high pressures and temperatures, prevents corrosion and "frozen joints," stays in uniform suspension, and does not spoil. Its lighter weight per unit of volume means a saving of 10 to 50 per cent as compared with other materials. Q-SEAL is standard with many leading industrial and utility power plants, gas plants, oil refineries, turbine manufacturers, etc. Let us send you a sample. Your test will prove our claims.

DAMIT—a plastic, non-corrosive filler for making up joints in pipe lines and equipment handling water, gas, air, and heating or process steam (less than 100 lbs. pressure). Non-poisonous—does not dissolve or emulsify with water—ideal for drinking water lines. And truly economical. Sample will prove.

Distributors with Stocks and Service in Important Industrial Centers Everywhere

Aberdeen, Wash.	Cambridge, Mass.	Elkhart, Ind.	Jacksonville, Fla.	New Haven, Conn.	Raleigh, N. C.	Syracuse, N. Y
Allentown, Pa.	Charleston, S. C.	Elkensberg, Wash	Kansas City, Mo.	New Orleans, La	Rochester, N. Y.	Tacoma, Wash
Anacortes, Wash.	Charleston, W. Va.	El Paso, Texas	Klamath Falls, Ore.	Norfolk, Va.	St. Johnsbury, Vt	Tampa, Fla.
Atlanta, Ga.	Charlotte, N. C.	Erie, Pa.	Lexington, Ky.	Olympia, Wash	St. Louis, Mo.	Toledo, Ohio
Bakersfield, Calif	Chattanooga, Tenn.	Evansville, Ind.	Los Angeles, Cal	Omaha, Neb	Salt Lake City, Utah	Troy, N. Y
Baltimore, Md.	Chicago, Ill.	Everett, Wash.	Louisville, Ky	Paducah, Ky	San Francisco, Cal.	Tulsa, Okla.
Beaumont, Texas	Cincinnati, Ohio	Fort Worth, Texas	Marshalltown, Iowa	Peoria, Ill.	Scranton, Pa.	Utica, N. Y
Bellingham, Wash.	Cleveland, Ohio	Grand Junction, Colo.	Marshfield, Ore.	Philadelphia, Pa	Seattle, Wash	Warren, Pa.
Binghamton, N. Y	Columbus, Ohio	Grand Rapids, Mich	Memphis, Tenn	Pittsburgh, Pa.	Shelton, Wash	Washington, D. C.
Birmingham, Ala.	Denver, Colo.	Hancock, Mich	Miami, Fla	Pocatello, Idaho	Shreveport, La.	Wausau, Wis.
Boise, Idaho	Des Moines, Iowa	Hartford, Conn	Milwaukee, Wis.	Port Angeles, Wash.	Spokane, Wash.	Wenatchee, Wash.
Bridgeport, Conn.	Detroit, Mich	Houston, Texas	Minneapolis, Minn	Portland, Ore.	Springfield, Mass.	Yakima, Wash.
Buffalo, N. Y	Durham, N. C	Indianapolis, Ind.	Muskogee, Okla	Providence, R. I	Springfield, Ohio	—and in 32 other countries

IN CANADA—QUIGLEY COMPANY OF CANADA, LIMITED—MAIN OFFICE AND FACTORY, LACHINE, P. Q.

To Plant Operating and Maintenance Men:

You will find our bulletins on each of the products above interesting and helpful. Write for those that interest you. If you would like samples or recommendations, please state purpose for which to be used.

QUIGLEY COMPANY INC.

Manufacturers of Industrial Specialties

56 West 45th Street, New York

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Estate scores again with

ESTATE LEVERACKS

ANOTHER scoop for Estate. An important improvement which gives those out-of-date ranges in consumers' homes another shove toward the junk pile.

Just a gentle pressure on the convenient lever brings both oven racks out, no matter how heavily loaded. By the same means, the racks are returned to their normal position. Hence, no more burned fingers from handling hot oven racks.

The range in the picture is the 500 Series Estate—sales leader of the 1934 Estate line. Other new features include: roller-sliding broiler and utensil drawers; new Hinge-Slide Top Cover (can be used in 4 different positions); improved, highly-efficient ring-type burner; increased size (width of range, 39½"); Time Control and automatic oven lighting (at extra charge); recipe card file; new finishes (white with black trim; ivory with black trim; ivory with tan trim).

Keep in step with Estate, and you're in step with the times. Write for new catalogue—No. 95.

THE ESTATE STOVE CO., Hamilton, Ohio

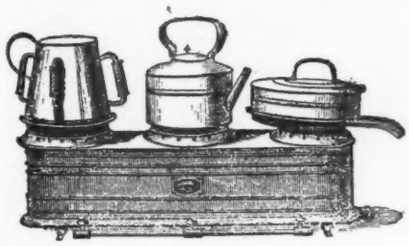
Warehouse stocks in New York, Boston, New Orleans, Dallas, Minneapolis, San Francisco, Los Angeles, Portland (Ore.).

Some Early History of Domestic Gas Appliances

Gas Range 52 Years in Continuous Service in Philadelphia, Pa. Removed March, 1933.

Gas Ranges

VOLUME production of gas ranges started in the United State in the early part of 1880. At that time gas was becoming widely recognized as the ideal fuel for cooking, and gas companies became very active in promoting the use of the gas stove in the home.



Eagle Gas Stove, 1864

Records show that the Eagle Gas Stove Works, New York, N. Y., announced a gas stove in August 1864. The illustration show that it was little more than a gas plate.

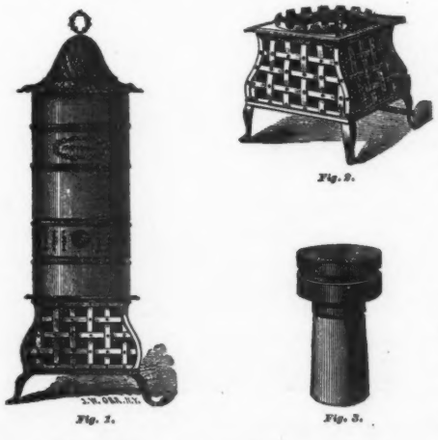
In July 1867, Dr. Musgrove's Cooking Stove was put on the market. In August 1867, the Etna combined gas stove and heater was introduced; illustration shows stove with burner enclosed. When not being used for cooking, the heating drum was placed over the burner.

In May 1877, the Retort Gas Stove Company, Providence, R. I., placed on the market a stove constructed, as they claimed, on an entirely new scientific principle. It superheated the gas before it was mixed with air.

In the September 17, 1877 issue of the JOURNAL appears the following editorial:

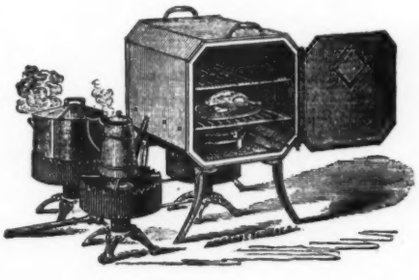
"So strong is the popular demand for gas as a fuel, that the manufacture of gas stoves is fast becoming one of the industries of the country. It needs but the cordial and sympathetic co-operation of the manufacturers of gas to work a common good to all concerned. When the gas stove manufacturer, the gas company, and the people are hand in hand in their efforts to bring about the use of gas as a fuel, then will be realized what should have existed long since—the economical and effective transportation of light and heat to every house within the reach of a gas main."

Dr. Margrave's Gas Stove, 1867.



Etna Gas Stove and Heater, 1867

In February 1879, W. Goodman & Co., Philadelphia, Pa., produced one of the first gas ranges, designed specially for hotel and restaurant uses. On October 16, 1879, Mr. Goodman read a paper before the Seventh Annual meeting of the American Gas Light Association on the economy of gas as a fuel for cooking purposes, in which was included a record of tests on boiling water over a flame composed of different proportions of gas and air. The chart is one of



Retort Gas Stove, 1877.

Retort Gas Stove Co., 1880.

the earliest of its kind and is shown herewith.

During 1879 and 1880 there was a great deal of discussion on the sale of gas stoves. The following letter from Mr. Frederic Egner, Engineer, City Gas Light Co., Norfolk, Va., is interesting:

Norfolk, Va.,
June 18, 1880

Mr. Editor:—

Having read with interest all that has been said of late in your Journal in relation to gas stoves, permit me to add my mite to that subject, and thus, perhaps, encourage others to do as we have done.

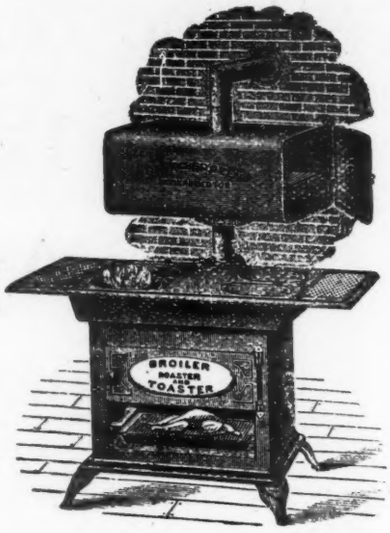
The gas company here, induced by their energetic president, rented and stocked a store with all kinds of gas cooking and heating apparatus and intend to add a gas engine. The public were—and are still—invited by liberal advertising to visit the store and inspect the stoves, burners, etc. Callers are received with every attention, and the stoves exhibited and explained while in actual operation. Responsible parties desiring to try a stove are supplied with any one which they may select, and the same is put up and left for trial, free of all charge, for thirty days, at the end of which time, if not satisfactory, they may be returned; and although the stove is in operation nearly four months now, and quite a number of stoves have been taken, none have ever been returned except a few which were returned to be exchanged for stoves of a larger size.

Hoping this may be of interest to your readers, and encourage any timid ones, of which you speak in your editorial of the 16th inst., I remain

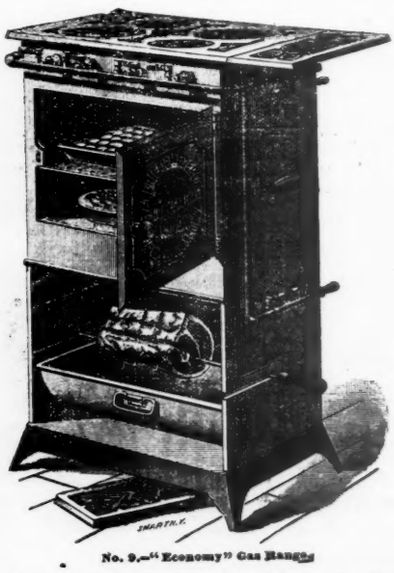
Yours truly,
FREDERIC EGNER,
Engineer City Gas Light Co.

In May 1882, Capt. W. H. White, Philadelphia, Pa., in discussing the sale of gas stoves, at the Seventh Annual Meeting of the Western Gas Association, held in Chicago, stated as follows:

"My experience has taught me that it is the hardest thing in the world to make gas men believe that gas stoves really amount to anything. One would suppose that there must be an antagonism existing between them. When the official receives a stove for the purpose of exhibition, he generally stows it away in the dampest and most obscure corner of his office, allows rust and mould to accumulate upon it until it becomes almost unrecognizable, and then calmly points to it with a finger of pride and tells his consumer that it is an elegant thing—that he ought to have one in his house. And yet in ninety-nine cases out of a hundred those who are most concerned in the introduction and extended sales of stoves — viz., gas manufacturers — have never even thought it worth their while to have them put up in their own residences. But they are always ready to sell the article to somebody else. When one wishes to dispose of any commodity of that nature, he should first understand it —become fully possessed of its merits from actual experience; and he will then be in a position to tell others all about it.

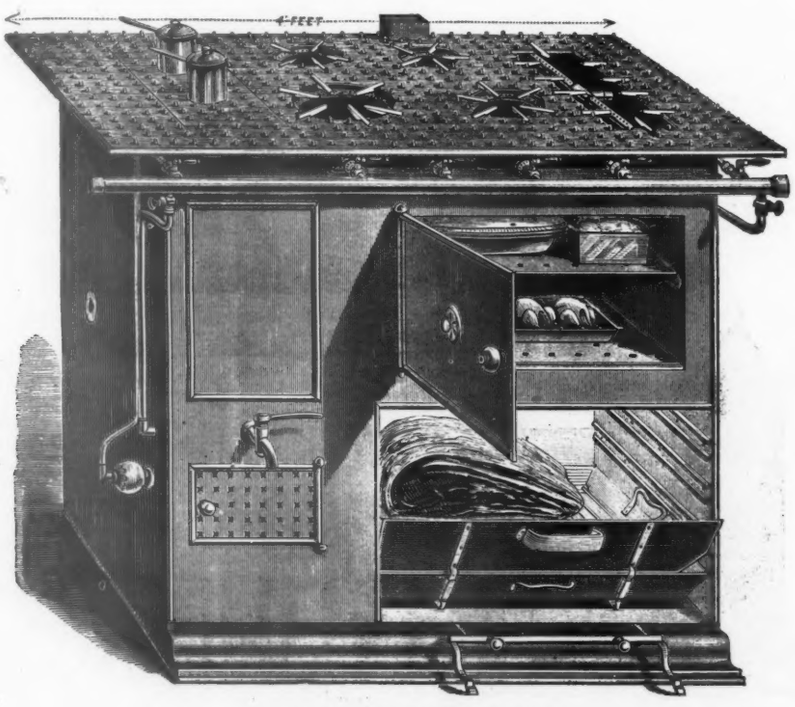


Shelton Gas Stove Co., 1883.



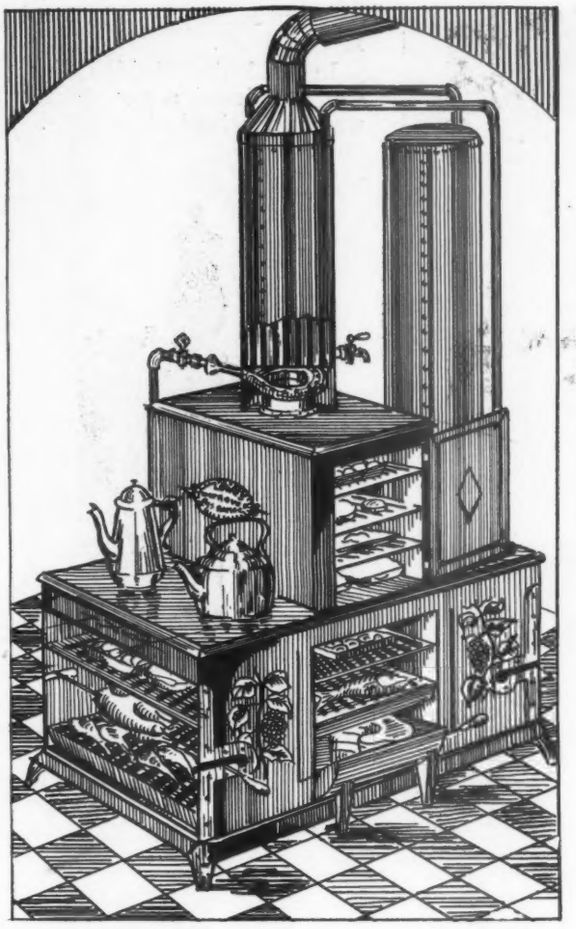
No. 9.—"Economy" Gas Range.

Manufactured by American Meter Co., 1881.



HOTEL GAS COOKING STOVE, No. 12.

First Goodwin Hotel Range, 1879.



Hotel Range designed by Prof. T. S. C. Lowe in 1884.
Note the tubular Water Heater forming a portion of the flue. In case the heat in the flue gases was not sufficient to heat the desired quantity of water, provision was made for an auxiliary ring burner to make up the deficit.

"Some years ago I took a gas stove home, but found its introduction strenuously opposed by the cook, she doubtless reasoning that if so convenient an article was brought into the household her services would no longer be regarded as indispensable. This difficulty overcome, the stove was given a thorough trial, and it is almost needless to add, proved an unequivocal success; it performed to the satisfaction of everybody, the cook especially.

"When a consumer is making inquiries in regard to the purchase of a gas stove, I always find that one of the first questions asked is, 'Have you ever tried one of them?' And if you can answer that you have, you very seldom have any trouble in making a sale."

The seed that grew into American Stove Company was planted in September, 1881, when two brothers, Charles A. and Louis Stockstrom started in business together to make gasoline stoves. It was not known as American Stove Company then but the two pioneers who nurtured the young plant are still its guiding spirits after more than half a century of active direction.

From the Gay Nineties, when the Stockstrom brothers turned from making gasoline stoves to the manufacture of gas ranges to today, there have been many developments and marked improvements in gas range development. For many of these, credit must be given to the Stockstrom brothers and the stove companies welded into one as American Stove Company in 1902.

These companies included the Quick Meal Stove Company, St. Louis—the original company organized by the Stockstroms—the George M. Clark & Company, Chicago, Ill.; Dangler Stove Company, Cleveland; Direct Action Stove Company, Lorain, Ohio; New Process Stove Company and the Reliable Stove Company, both of Cleveland, Ohio.

The ranges were similar in design and all looked alike except in minor

Tabular Record of Tests on Boiling Water over a Flame Composed of Different Proportions of Gas and Air, under Different Conditions.—Coal Gas, 16½-Candle Power. Weight of Water, 8 Pounds.

1879	No. Trial	Temp. of Water.	Increase of Temp.	Time Required.	Gas Consumed.	Per Cent. Less Time.	Per Cent. Less Gas.
		Degrees.	Degrees.	Minutes.	Feet.		
Test No. 1—Pure gas at the rate of 10ft. pr hour	1	70	132	28.5	4.5	.....	.....
	2	76	136	28.5	4.4	.....	.....
	3	76	136	28.5	4.5	.....	.....
	Av'ge	77⅓	134⅓	28.5	4.466	.....	.....
Test No. 2—1 vol. mes of gas and 1 of air.	1	80	132	22.5	3.6	.....	.....
	2	74	188	23	3.6	.....	.....
	3	74	188	23	3.6	.....	.....
	Av'ge	76	136	22.83	3.6	20	19
Test. No. 3.—1½ volumes of air to 1 of gas.	1	78	134	22	3.4	.....	.....
	2	76	136	22.25	3.5	.....	.....
	3	76	186	22	3.5	.....	.....
	Av'ge	76.6	135.3	22.08	3.46	27.5	22
Test No. 4—2 volumes of air to 1 of gas.	1	79	133	21	3.3	.....	.....
	2	76	136	21.5	3.4	.....	.....
	3	76	136	21.5	3.4	.....	.....
	Av'ge	77	135	21.3	3.33	25	25.5
Test No. 5.—2 1-6 volumes of air to 1 of gas.	1	71	141	21.25	3.5	.....	.....
	2	74	136	22	3.5	.....	.....
	3	76	136	21	3.3	.....	.....
	Av'ge	73.66	138.3	21.4	3.3	26	26.1
Test No. 6.—2 1-6 volumes of cold air to 1 of heated gas	1	73	139	28	4.1	.....	.....
	2	74	138	26	3.8	.....	.....
	3	76	138	27	3.9	.....	.....
	Av'ge	73.66	138.33	27	3.93	5.3	11
Test No 7.—2 1-6 vols. of heated air to 1 of heated gas.	1	74	136	27	4.0	.....	.....
	2	74	138	26.5	3.9	.....	.....
	3	74	138	26.75	3.9	.....	.....
	Av'ge	74	138	26.75	3.93	6	11
Test No. 8.—2 1-6 vols. of heated air to 1 of cold gas.	1	74	138	26.5	3.9	.....	.....
	2	78	137	26.25	3.8	.....	.....
	3	76	136	26	3.8	.....	.....
	Av'ge	75	137	26.25	3.83	7.8	12

Chart issued by Goodwin Stove Co.

THE FOLLOWING TABLE OF COMPARISON BETWEEN COST OF COOKING BY COAL AND GAS IS THE RESULT OF ACTUAL TESTS MADE BY US.

RECORD OF PEERLESS COAL RANGE, No. 8.						RECORD OF No. 7 GAS STOVE.				
ARTICLE.	How Cooked	Weight Before Cooking	Weight After Cooking	Loss per cent.	Time	How Cooked.	Weight Before Cooking	Weight After Cooking.	Loss per cent.	Time
Blue Fish	Baked	3 lbs.	2 lbs. 1 oz.	32	31 m.	Baked	3 lbs.	2 lbs. 6 oz.	20	35 m.
Rib of Beef	Roasted	9 lbs. 7 oz.	6 lbs. 6 oz.	32	1 h. 37 m.	Roasted	9 lbs. 4 oz.	7 lbs. 11 oz.	17	1 h. 05 m.
Chicken	Roasted	3 lbs.	2 lbs. 2 oz.	29	1 h. 6 m.	Roasted	3 lbs. 1 oz.	2 lbs. 10 oz.	14	1 h.
Beef Steak	Broiled	1 lb. 2 oz.	13½ oz.	25	11m.	Broiled	1 lb 2 oz.	15 oz.	16¼	6 m.
Lamb Chops	Broiled	1 lb. 1 oz.	11 oz.	25	10m.	Broiled	1 lb.	13¼ oz.	15	10 m.
Sweet Potatoes	Steamed	3 lbs. 5 oz.				Steamed	3 lbs. 5 oz.			
White Potatoes	Steamed	3 lbs. 8 oz				Steamed	3 lbs. 8 oz.			
Cauliflower	Boiled	2 lbs. 12 oz.				Stewed	4 lbs.			
Tomatoes	Stewed	4 lbs.				Boiled	3 lbs. 12 oz.			
Bread	Baked		5 lbs. 2 oz.		46 m.	Baked		5 lbs. 7 oz.		37 m.
Sago Pudding	Baked		3 lbs. 5 oz.		27 m.	Baked		3 lbs. 3 oz.		29 m.
Lemon Pie	Baked		2 lbs. 12 oz.		30 m.	Baked		2 lbs. 14 oz.		32 m.
Sauces for fish, beef and cauliflower.						Sauces, etc.				

Total time from lighting of fire until everything was ready to serve, 2 hours and 40 minutes. Of this time 30 minutes was required to heat the oven, leaving 2 hours and 10 minutes actual cooking time. Weight of coal including lighting of fire, 44 lbs. At the end of the time the fire was ready for more coal. Cost of coal, 41 lbs., @ $5.50 per ton, 10.35 cents. Kindling 1 cent. Total 11.95 cents.

Total time from lighting of gas until everything was ready to serve, 1 hour and 50 minutes. Consumption of gas by test meter 36 feet, cost 8.17 cts.

Cost of Coal	11.95 cents.
" Gas	8.17 "
Saving over Coal	3.78=46 per cent.

Chart issued by Goodwin Stove Co., 1882.

American Stove Co., Early model.

1934 Model Kitchen.

features. Improvements, if they could be called such, consisted mainly in ornamental changes which had no bearing on efficiency. It is only in the last twenty years that all of the real practical improvements in gas ranges have been made.

The first major development was the invention of the Red Wheel Lorain Oven Regulator in 1915 by an engineer of the American Stove Company. This was the first oven regulator in the field and the most outstanding improvement in gas ranges made up to that time or since. Time and Temperature Cooking, inaugurated by the Red Wheel, revolutionized cooking methods and forever removed guesswork and oven watching from the culinary art.

The Estate Stove Company, Hamilton, Ohio, built its first Estate Gas Range in 1883.

The first Estate, christened "Bijou," was cast-iron nickel-plated range bearing a profusion of decorative design.

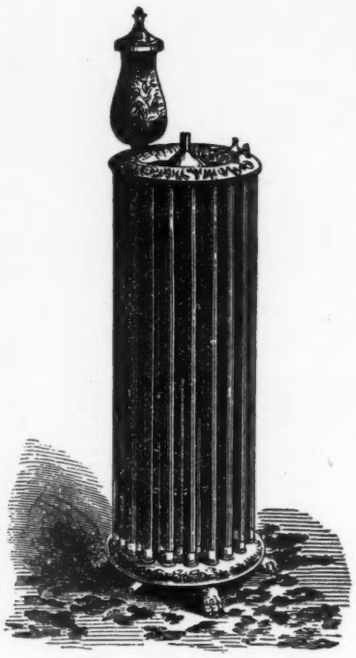
In 1891 the Estate Ventilated Oven was patented, and the principle of this design, with material improvements, is embodied in the Estate Fresh Air Oven of today.

In 1885, George D. Roper, Rockford, Ill., designed his first gas range, known as the Eclipse. From that time a number of manufacturers began the production of gas ranges. About 18 years ago the porcelain enamel range made its appearance, and we are all familiar with the trend since then.

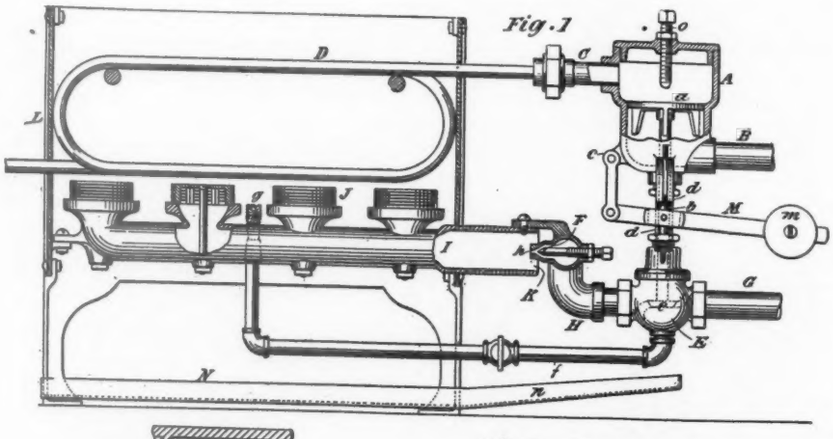
Gas Water Heating

One of the earliest methods of heating water by gas was a hot water gas stove, made by Hunter-Keller & Co., New York, the latter part of 1860. There is no record of much development of gas water heating for several years.

In 1883 the Sheldon Gas Stove Co. introduced a gas stove with a water back, hooked up to a 40-gallon tank.



Hunter, Keller & Co., Hot Water Gas Stove, 1860.



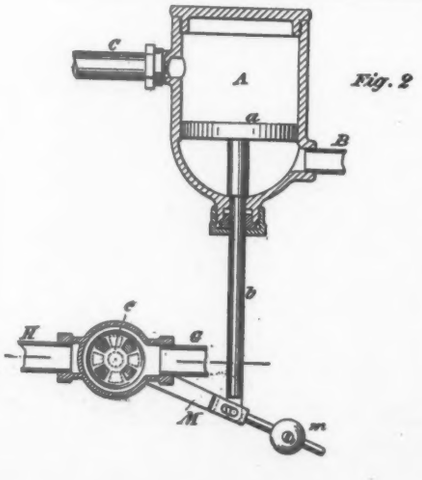
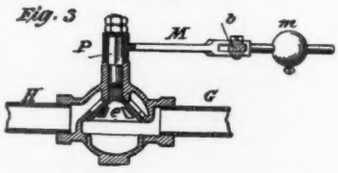
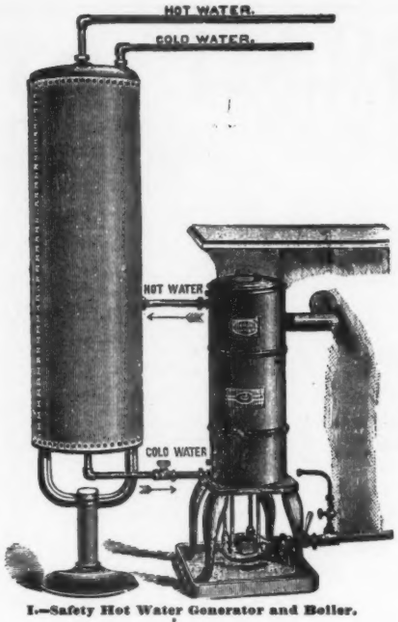


Fig. 2



First Patent, Instantaneous Water Heater —1897.

Fig. 1—"A" indicates a chamber connected with a water supply pipe "B." In the chamber "A" is located a valve disc piston head. Pipe "C" leads to the heater coil "D," where water passes by branch pipes to hot water cocks throughout the building. The valve chamber "E" is connected with gas pipe "G." Figs. 2 and 3 show the rotary chronometer valve.



I.—Safety Hot Water Generator and Boiler.

Goodman Gas Stove Co., 1885

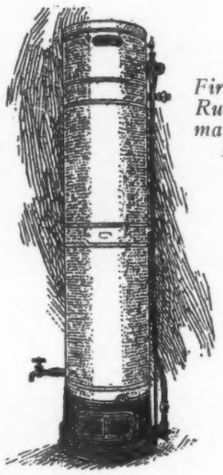
In 1885 the Goodman Gas Stove Co., Philadelphia, Pa., introduced a gas water heater.

In the early part of 1890, the Jewell Circulating Hot Water Heater was introduced.

In June 1897, U. S. Letters Patent was granted to William C. Clark for "new and useful improvements in apparatus for heating water." The drawings would indicate the heater to be of the instantaneous type.

In 1889 the first automatic gas water heater was manufactured. First patents were issued in 1890. This was the product of the Fuel Gas and Electric Engineering Co., with which Mr. Edwin Ruud was associated. This company was a division of the Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa., and the heater was developed by Mr. Ruud. He purchased the patents from the Westinghouse Company. A little later James Hay joined Mr. Ruud, and the first water heaters were marketed under the trade name of "Pittsburgh Water Heater" and manufactured by The James Hay Co. In 1897 the Ruud Manufacturing Co. was incorporated.

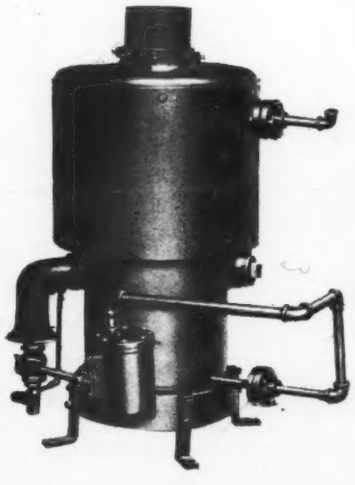
In 1895 Mr. J. C. Beckfield, formerly associated with the Westinghouse Co., built an automatic water heater. The company formed to manufacture water heaters was The Water Heater Manufacturing Co. In 1897 its assets, patents, etc., were transferred to the Beckfield Water Heater Co., which was a little later called the Monarch Water Heater Co. Later the Monarch Company was taken over by the present Pittsburgh Water Heater Co. All of us are familiar with the development of gas water heating in recent years.



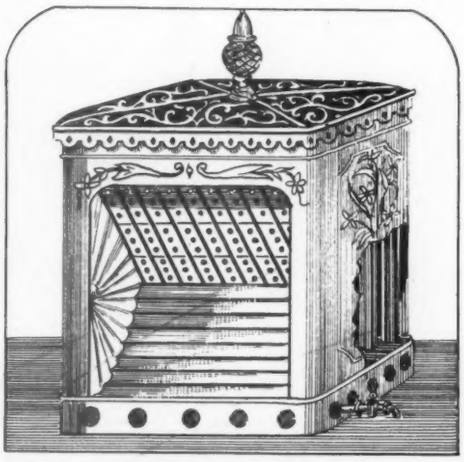
First Model Ruud Automatic Water Heater.

Room Heaters

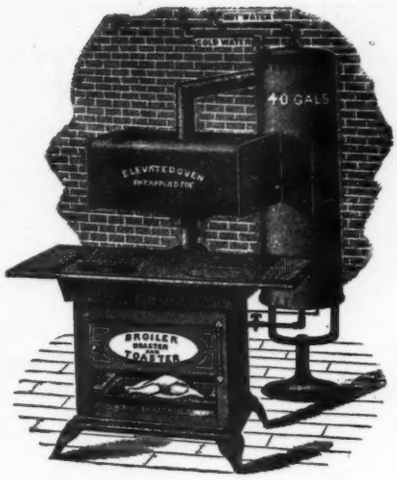
The- development of gas fired, room heaters started in the late seventies. An accompanying illustra-



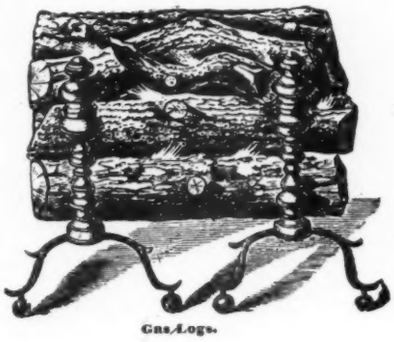
First Model Pittsburgh Water Heater Co.



Room Heater Designed by Prof. Lowe.



Sheldon Combination Gas Stove and Water Heater, 1883



American Meter Co., 1883.

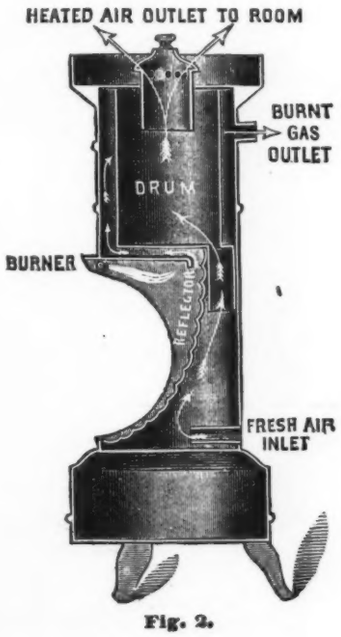


Fig. 2.

Goodwin Portable Room Heater, 1881.

Continued on page 153.

1934 Model Gas Ranges

THE development of the gas range can be visualized by comparing the early units shown on the preceding pages with the present-day models shown herewith. Surely, the kitchen has been made beautiful and its routine carefree, by reason of the splendid gas ranges which are now available.

The "Glenwood" 1934 Model with "Easy Clean" Top equipped and "Speedlux" Burners.

American Stove Company, 1934 Model—"Magic Chef" —with Cooking Top Cover and Handy Utensil Compartment.

The "Estate" 1934 Model with Built-in Radio, Recipe File Box Combining Time and Temperature Chart.

Roper 1934 Model—"Air Stream"—with Two-In-One Oven Control (Radio Dial Type)

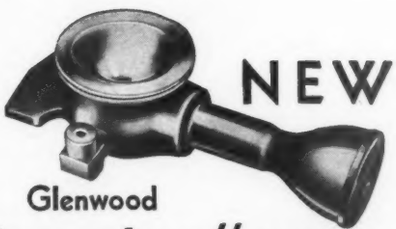
For LARGE VOLUME SALES

This New POPULAR PRICED

Glenwood

TABLE-TOP MODEL

Here's a range that has all the requirements you need to build volume in gas range sales this year. It's a masterpiece in design, in construction, in utility. A real value. Its low net cost makes every gas user on your lines a new range prospect, enabling you to offer all these up-to-date cooking features at a popular price. Thorough leak-proof, blanket type insulation folded around ovens and top! Heat control! Automatic lighting! SpeedLux burners! Easy-clean top and Draw-out Broiler! Acid-proof, stainless enamel top! And last but not least, it carries the famous Glenwood name, recognized everywhere as a mark of quality and dependability.



NEW

Glenwood

"SPEEDLUX" BURNER

This is the speedy and clean, new ring-type burner. It has no holes to get clogged. Just a round brightly polished disc that produces a ring of clear blue flame that heats more evenly and allows closer regulation of heat than ever before.

Astogril Broiler

Furnished at a slight extra cost. Makes gas broiling cleaner, easier and more popular than ever before.

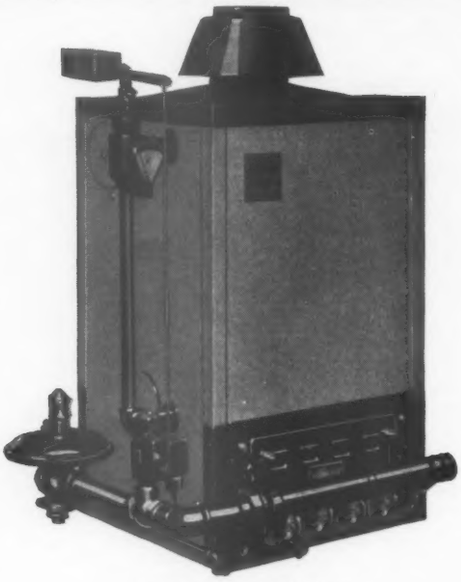
For complete information write to **Glenwood Range Company, Taunton, Mass.**

New York Office, 101 Park Ave.— Boston Office, 250 Stuart St.

Dependable AGP Products

A. G. P. Gas Fired Automatic Storage Water Heater

Made in galvanized or Everdur tanks. 20-25-30-40-75 gallon sizes.



Ideal Gas Fired Boilers

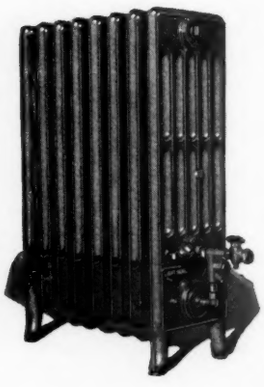
A. G. A. Steam Rating 270 to 16,000 Sq. Ft.
A. G. A. Water Rating 210 to 25,600 Sq. Ft.

The "Dictator" Low-Priced Water Heater

Made in galvanized or Everdur tanks.—15-20-30-40 gallon sizes.

A. G. P. Gas Fired Steam Radiators

Unvented in 26-32-38" heights. Ratings from 34 to 175 sq. ft. Vented made in 38" height only. Ratings from 28 to 99 sq. ft.

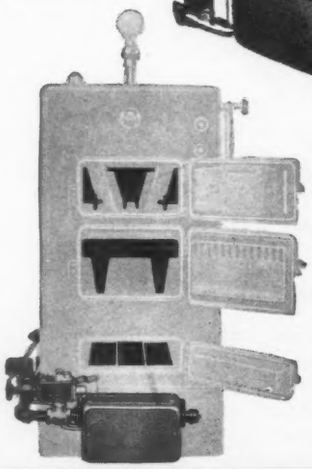


UNIT-OR Gas Fired Heater

Warm air convection type circulating heater. Enclosed in attractive cabinet finished in walnut or crystalline green enamel. The Unit-Or is so designed that it can be used either with or without a flue connection, with no material change or addition. Ratings from 70 to 110 sq. ft. equivalent C. I. Radiation.

Ideal Gas Convertor

Changes any type of furnace or round boiler into an efficient, automatic gas fired heating system. All controls are mechanical and centered in one valve. Fits all types of round boilers and furnaces. Special equipment makes it a "tailor-made" job for Arco Round Boilers, eliminating engineering on the job.



A. G. P. Redflash Gas Convertor

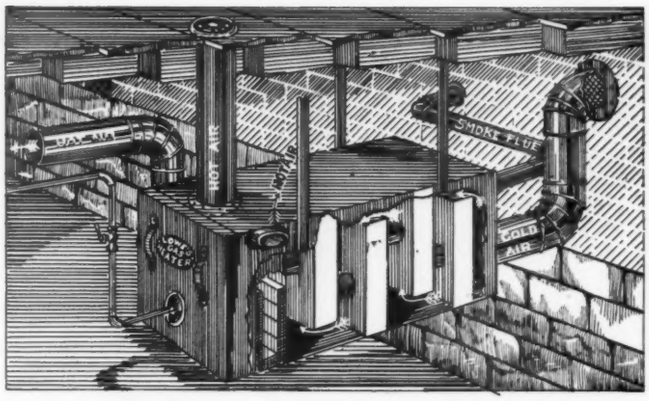
Especially designed only for all sizes No. 1 Ideal Redflash Boilers. Full automatic controls same as used on Ideal Gas-Fired Boilers, with or without room thermostat.

AMERICAN GAS PRODUCTS CORPORATION

40 WEST 40th STREET, NEW YORK, N. Y.

Division of AMERICAN RADIATOR COMPANY

Gas Heating— A Brief Review of Its Development



Hot Air House Heating Furnace designed in 1884 by Prof. T. S. C. Lowe. As can be observed, this unit was suspended from the ceiling joists

By THOMSON KING

Ass't. Mgr. in Charge of Gas Sales, Cons. Gas Electric Light & Power Co., Baltimore

IN THE beginning and for many years, gas was used exclusively for lighting. Cooking and water heating came next. Its use for heating and industrial processes, except for certain localized cases with natural gas, has been a development of comparatively modern times, and the very wide application and extension of these uses have taken place in our own day and generation.

The first gas heaters that achieved popular acceptance seem to have appeared in the 1880's. They used illuminating tips for burners and had copper reflectors. We find among early patents: "Air Heating and Drying Apparatus 1886"; "Gas Heating Burners for Stoves or Fireplaces 1889"; "Gas Fireplaces Asbestos Front Type 1895."

Popular Natural Gas Heater

The last mentioned type of heater, using a vertical expanse of woolly asbestos, became very popular in the natural gas territory of Ohio, West Virginia, and Western Pennsylvania. Thousands of them were installed in Pittsburgh, Cleveland, and other cities and towns. The heating effect and efficiency were very much those of the open fireplace. The visual effect was cheerful and pleasant. Heat was delivered principally by radiation. The loss of heat up the flue was enormous.

Efficiency had not become the word it is today, and no one worried very much about it. Natural gas sold at 25 or 35 cents per M, and the supply seemed to be unlimited. Many houses had a gas fireplace in every room. Steam and hot water radiation systems had not yet come into general use; warm air systems were crude and unsatisfactory. For many years the gas fireplace heater contributed very greatly to the volume of gas sold.

The abundant supply of cheap, high heating unit natural gas and the increasing popularity of steam and hot water heating, naturally, led to the development of larger heating units. About 1908 we begin to find gas boiler and warm air furnaces appearing in the natural gas regions. The Bryant Heater and Manufacturing Company built their first cast iron sectional gas boiler in Cleveland in 1909. The Peerless Heater Company began to build boilers of the same type in Pittsburgh a little later.

The Bryant Company was soon distributing their product through the natural gas regions. The largest unit they designed and built in the early days had a steam rating of 800 square feet, and it was felt at that time that such a unit would, certainly, be as large as there would ever be a demand for, little dreaming that 16 years later they would be building units of 11,000 square feet of steam capacity and selling quite a number of them.

Up to 1916 the gas boiler market was restricted to the eastern natural gas fields. Operating costs were low and the manufactured properties had not realized the possibilities of securing large heating installations. Although these early boilers were quite efficient as far as heat absorption at full load was concerned, it was general practice to bypass one or more of the main burners to act as pilots, a condition that did not tend to produce the best all-season efficiency.

Another early form of gas heating was the gas steam radiator. This consisted of a regular steam radiator below which was a sheet metal box or housing, inside of which there was a gas burner. Such radiators represented a great increase in efficiency over the gas fireplace heater that had already proved so popular. As a matter of fact, since they were unvented, they were theoretically 100% efficient, although practically the room had to have liberal ventilation to keep down the humidity. They represented the first application of gas to a steam radiation system. The fact that they were individual gas fired radiation units that could be installed in whatever position was most convenient and that the radiating surfaces were worked at a comparatively low temperature, gave a distinct advantage not possessed by any previous device.

The gas steam radiator was invented by Robert Calef in 1897 in Massachusetts. He wished to produce a gas fired heating system which would have the advantages of radiator heat and the flexibility and economy of individual room heaters. James B. Clow and Sons purchased Calef's patents in 1902. From then until the present time, this firm has sold over 300,000 gas steam radiators.

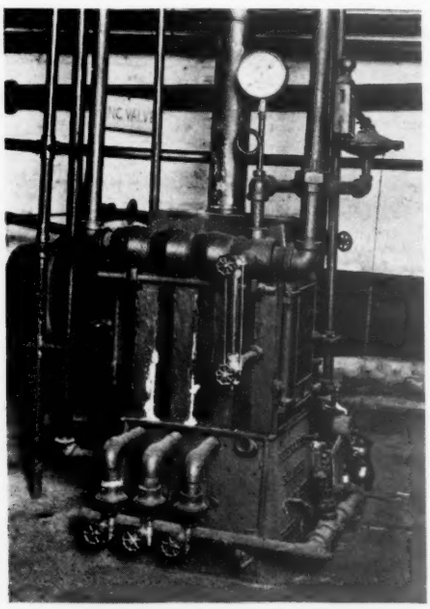
Developments in Manufactured Territory

The Proceedings of the National Commercial Gas Association for the Year 1912 carry the first important mention of a discussion of House Heating by gas. This address, "The Possibilities of House Heating by Artificial Gas as a Fuel," was delivered by Mr. A. F. Krippner, Industrial Engineer of the Laclede Gas Light Company, St. Louis, Mo. It indicates that experiments on central house heating were begun in St.

Louis eight years previous to 1912.

At the conclusion of the address Mr. J. H. Maxon, of Muncie, Ind., suggested the appointment of a committee on the subject of house heating and further suggested that the committee cooperate with a committee from the Natural Gas Association. In 1914 at the annual convention of the National Commercial Gas Association, in December, Mr. George S. Barrows, of Philadelphia, Chairman of the Committee on Heating, Ventilation and Refrigeration, reported for his committee and apparently this is the first heating committee organized in the National Commercial Gas Association. Some attention was given to central plant heating but the majority of the report referred to auxiliary heating.

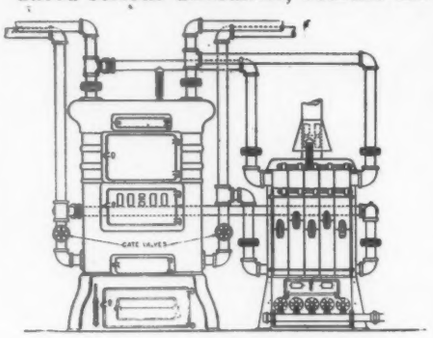
The American Gas Association was organized in 1919 and it had a



An Old Timer—Peerless Steam Boiler Installed 1912. Still Giving Satisfactory Service.

heating committee beginning with this organization. This committee was also headed by Mr. Barrows.

About 1913, the Rector System of gas heating made its appearance. This was an ingenious system in which gas was burned inside of cast iron radiation. A vent from each radiator was led to a central point, usually in the basement, and a suction fan drew the products of combustion from the radiators and discharged them to the outside atmosphere. Each radiator was equipped with a thermostatic device. A good many installations of this system were made and the efficiency secured was very high; as the products of combustion were cooled below the condensation point, over 95% of the heat was delivered into the house. Its very high efficiency, however, introduced serious difficulties, because the



From an early catalog. Diagram for cross-connected boilers.

condensation, being slightly acid, rapidly corroded the inside of the vent pipes and accumulation of scale soon caused complete stoppages of the vent pipe. Since these were often run concealed, serious troubles shortly developed. Considerable trouble was, also, experienced with the thermostatic control. As a result of these difficulties, the installations were usually removed after comparatively short service.

February, 1916, is an important date in the development of gas heating, for at that time the Consolidated Gas Electric Light and Power Company of Baltimore decided to undertake the development of gas heating on their lines on a large scale. A rate for residences having a secondary step of 35 cents per M was announced and the company undertook extensive studies and investigations to develop the best means of heating houses and buildings by gas. They experimented and collected data on the cost of heating for residences by means of individual gas radiators, by gas boilers and furnaces, and with conversion burners.

Up to this time the gas boilers for steam and hot water systems had been confined to the natural gas regions. It was, therefore, necessary for the Baltimore company to redesign the burners for use on manufactured gas. They also began to build their own conversion burners. They made these from pipe, usually bent in the blacksmith shop to conform to the inside diameter of round boilers and drilled for the amount of gas necessary for each installation. Cores and baffles of firebrick were built up in the firepots of the boilers and furnaces. A large amount of data was collected and very satisfactory results were obtained. Eighty-six (86) installations were made the first year and 395 in 1917. Activity was curtailed in 1918 on account of the war, but by the end of 1920 over 1300 central gas heating installations had been made.

A by-product of the efforts of the Baltimore Company to improve their burners was the application of the Venturi tube to gas burner design. This was first used in Baltimore in 1918. The data necessary for the use of this important improvement in design was given to the industry in the report of the first Industrial Fuel Committee of the American Gas Association in 1919, and also appeared a little later in a bulletin of the U. S. Bureau of Standards, prepared by W. M. Berry, who had served on the American Gas Association Committee. This improvement in the efficiency and capacity, which grew out of the necessity of better burners for heating, has had a profound influence upon the design of atmospheric burners, and constitutes the most important contribution to the subject since Bunsen.

Other companies in the manufactured territory were interested by the example of the Baltimore company and began the development of central gas heating.

Before the days of jackets—Bryant boiler with asbestos covering.

There was an essential difference between the attitude that existed among the gas companies in the natural territory and that of the manufactured gas companies that went into house heating. In the natural territory at that time the gas companies took very little interest in the appliances used or their installation. The functions of the company stopped at the meter. Very little service was rendered, and all installations were made by the heating trade. With the advent of manufactured gas companies into the heating field, selling gas

at a much higher cost than the natural product, sales of heating equipment were made by the gas companies and installations were carried out by their men or under their close supervision. Inspection and complaint service was rendered by the company forces and a lively interest was shown in the performance of the equipment.

On account of the relatively high rates then in force, the increase of gas heating during the years following the World War was quite slow. The companies had a great deal to learn about heating and about equipment. At the same time, the days of abundant supply of natural gas in the eastern territories were over and serious shortages of supply during cold weather seriously retarded and, in fact, decreased the installation of central heating plants in those regions. In some cities, such as Buffalo, the conditions of supply were such that the installation of central heating plants practically ceased and many existing plants lay unused or were removed.

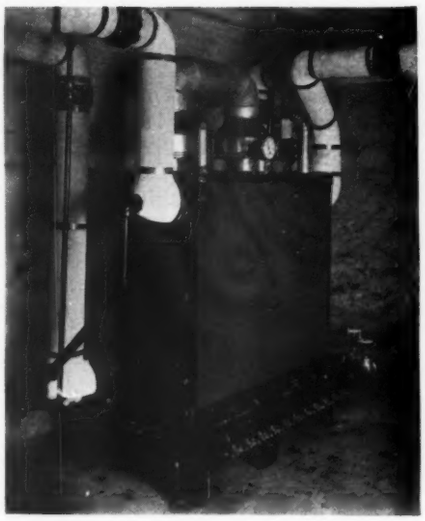
Fear of gas shortages in natural territory and lack of confidence in something new in manufactured territory, led to the frequent use of cross connected installations; that is, a gas boiler or furnace connected beside the coal furnace so that either could be used. As reliability of supply was restored in natural territory and gas heating became more familiar in manufactured gas properties, this type of installation gradually dwindled and is now seldom used.

The boilers and furnaces that were first installed in the manufactured gas territories were practically always equipped with thermostatic control and gas pressure regulators. The safety pilots, aquastats and low water cut-offs did not come into general use until about 1925.

Up to this same time, the gas boilers were furnished without jackets and were insulated, if at all, with asbestos or magnesia coverings after installation. Needless to say, the quality and insulating properties of these coverings varied very widely and the appearance was often crude and ugly. About 1925 the sheet metal jacket with insulation between jacket and boiler made its appearance and rapidly became popular, in the course of time entirely supplanting the older method.

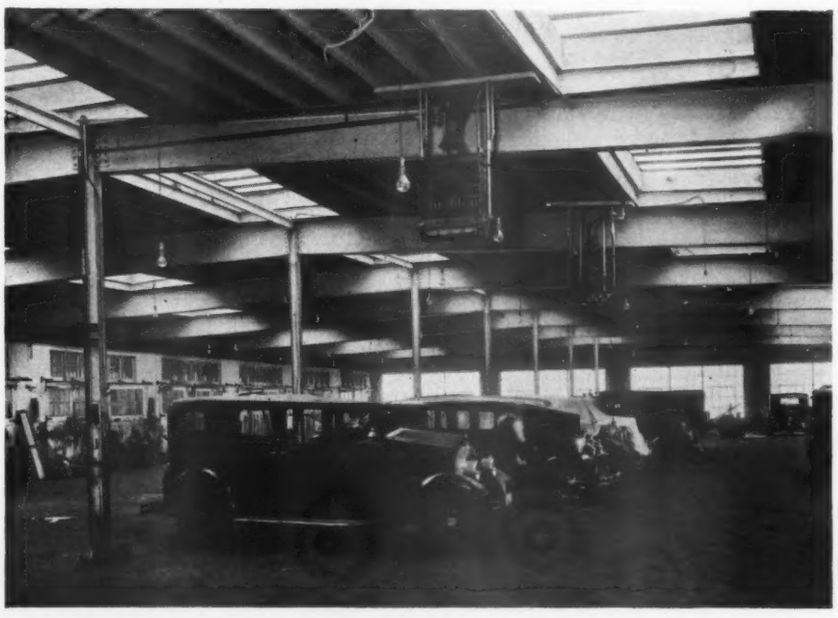
The change in the outward appearance of the boiler was a significant part of a change that was being brought about by gas heating and modern domestic appliances in the whole attitude of the home owner toward his basement or cellar. He was beginning to realize that when the use of gas eliminated the coal bin and the handling of coal and ashes from his basement, this space, usually as large as any floor in his house, could be kept neat and clean and would lend itself to many uses that were not possible before. Even the gas company men, who were selling heating, were slow to realize the possibilities and potentialities of this development.

We are, today, just beginning to realize the possibilities of basement improvement and basement use. The attitude of both home owners and architects has completely changed. When a new house is being planned, the basement is no longer dismissed without a thought. Its treatment is discussed and considered, with the consequence that the home owner adds greatly to the useful contents of his house at small additional cost.



The jacketed boiler appears.

At about the same time that gas boilers and furnaces were acquiring a new outward appearance and additional automatic controls, the size of sections and units was being greatly increased. As early as 1916 the Peerless Heater Company had designed and made patterns for a large section boiler. This, however, was never produced. In 1925 the same company produced and began to sell a boiler having sections about three times as large in capacity as the sections that had been standard up to that time. The advantages in reduction of manufactured costs and in saving of floor area for a given capacity, were immediately apparent. This first large section boiler was followed by other makes and the large sections immediately became popular for all larger heating installations. Many gas companies made installations for the heating of their own buildings.



A later development. United heaters well adapted for large open spaces.

Competition Changes

In the early days of gas heating and for some time after 1920, gas was almost alone in its position as an automatic fuel. In the years following 1920, the development of the oil burner was progressing rapidly and gas heating found itself confronted with a rapidly growing competitor that claimed the same automatic features that have given gas its pre-eminence over all solid fuels. Gas could still claim to be the only entirely automatic fuel since the supply and delivery were truly automatic, and were not so with any liquid or solid fuel.

Gas also had other important advantages in the simplicity and long life of its equipment. The contest was on—in many localities oil claiming a large advantage in low operating costs, gas depending upon its advantages of form, safety, cleanliness, etc. This contest is still raging and is being fought out all over the country with varying success, depending upon the local conditions and the energy and ability that is shown on either side in each locality.

The automatic coal stoker began to assume some importance for domestic and smaller commercial application around 1930. It has not, however, been able to seriously dispute the field of automatic heating with gas and oil.

The Radiantfire Type Appears

After the decline of the asbestos faced fireplace heater of the natural gas regions, the next significant development in radiant type space heaters was the "Radiantfire," produced by the General Gas Light Company in 1916. This type had been in use in Great Britain for some years. It was considerably modified and improved when introduced in this country. It soon became very popular, and its popularity and wide use have continued to the present time. The sheet iron heaters with copper reflector, one of the earliest types developed, were and still are in general use and the variety of form and size that is now available among gas space heaters is almost infinite.

In 1928 the General Gas Light Company announced their gas fired unit heater. This was first shown at the American Gas Association Convention of that year. This heater represented an important development in the industry. Since it was designed to be hung from beams or joists, it required no floor space. Its use of a motor-driven fan to distribute the warm air it produced gave it all the advantages that the steam unit heater had already demonstrated, while the fact that it was a complete heating plant in itself that could be placed almost anywhere, requiring only a gas supply pipe and a vent, gave it a very great advantage over the steam unit heater that was dependent upon some distant steam boiler and required insulated flow and return mains if it were to operate efficiently.

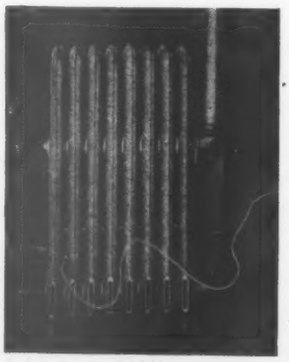
This device opened a new and wide field for gas heating application. It has been deservedly popular and will, we believe, continue to grow in use and esteem.

The Gas Househeating Furnace has converted the Cellar into a Play Room.

The opening of mid-continent and Pacific Coast natural gas territories introduced some new features into gas heating. In these regions warm air heating was very popular and widely used. Gas was fairly cheap and good coal was not so near at hand as in the East. Consequently, the proportion of conversion burners was high and all types of gas warm air furnaces found wide application. The warm air floor furnace has always been popular in the West, but has made little progress in the East. In the warmer sections, the use of space heaters has grown to enormous proportions.

With the extension of the long natural gas pipe lines from the great fields of Oklahoma, Louisiana, Texas and California, gas has also been able to take over the firing of boilers for very large buildings. For this purpose, there has been a rapid and extensive development of very large burners and of the technique of the application and control of gas in these large heating installations. We can now safely say that no heating application is too small or too large to be handled by proven gas burning equipment.

In recent years the most important developments have been the long pipe lines bringing natural gas from remote fields to the great centers of population, the making of lower rates designed to obtain large volume heating business in both natural and manufactured territories, and a steady improvement in the appearance and the control equipment of gas heating appliances. Notable among these are improved thermostats with electric clocks, the use of devices to cut off the flow of air through boilers and furnaces when the gas is off, and refinement of design for neatness and beauty of form.



Cast Iron Radiator Vented Gas burned in the Sections

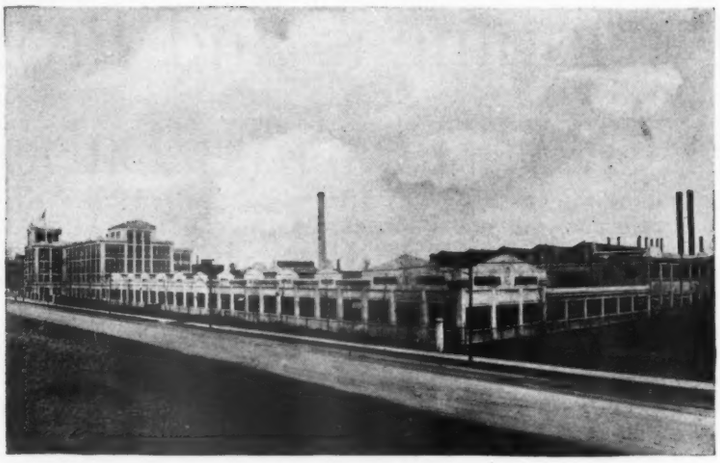
The growth of gas for heating since its humble beginnings, has been tremendous. It is not possible to ascertain or present any figures that show the total amount of gas used for heating purposes and the revenue from this gas, because, while most companies may have a fairly accurate idea of the amount of gas used in central heating installations, very few of them have any means of ascertaining how much gas is used in space heaters for auxiliary and incidental heating.

What the Statistics Show

What statistics there are available indicate that for the year 1932, the consumption of gas for central heating installations and buildings heated entirely by gas was 19,666,000 M.C.F., and the revenue from these sales was $15,148,000.00. It is almost impossible to give an accurate estimate even of the central heating gas for natural territories, as many of the companies do not know what proportion of their load is heating. If we use a figure of 20%, which is probably rather too conservative, we arrive at heating consumption in natural territories of 100,000,000 M.C.F. and a revenue of $60,000,000.00 for the heating load.

A significant development of the last year has been the undertaking of the great mass selling campaign for gas heating in the Chicago territory. This campaign was conceived on a far greater scale than anything hitherto thought of. The results that have already been achieved seem to demonstrate that the possibilities for a rapid extension of gas heating are very great.

Gas is the most perfect of fuels. Many problems remain to be solved in distribution and rates, but the conclusion seems inevitable that these will be gradually worked out and that it will eventually attain its manifest destiny and become the accepted and universal medium for the automatic heating in those localities where it can be economically distributed.



THIS 8½ ACRE PLANT . . . THE NEW HOME OF

AMERICAN-BOSCH KOMPAK

Here is a photograph of the 8½ acre plant of the United American Bosch Corporation at Springfield, Massachusetts.

Here in this plant have been developed products that have made American-Bosch famous throughout the land. The American public knows from experience that the products of this plant — American-Bosch Radio, Coils, Magnetos, etc. — are in a class by themselves for dependable quality.

Here in this plant American-Bosch Kompak Water Heaters will be produced under the direction of Mr. H. J. Long, former president of the Kompak Company, New Brunswick, N. J., leading authority on gas water heating.

The resources for technical research and manufacture which have won leadership for American-Bosch in automotive and radio products, will be extended to promote still further the development of American-Bosch Kompak Water Heaters. And Kompak is already recognized as a leader in the field of gas hot water heaters.

GAS APPLIANCE DIVISION,

UNITED AMERICAN BOSCH CORPORATION

SPRINGFIELD, MASS.

The Development and Progress of The A.G.A. Testing Laboratory

By R. M. CONNER

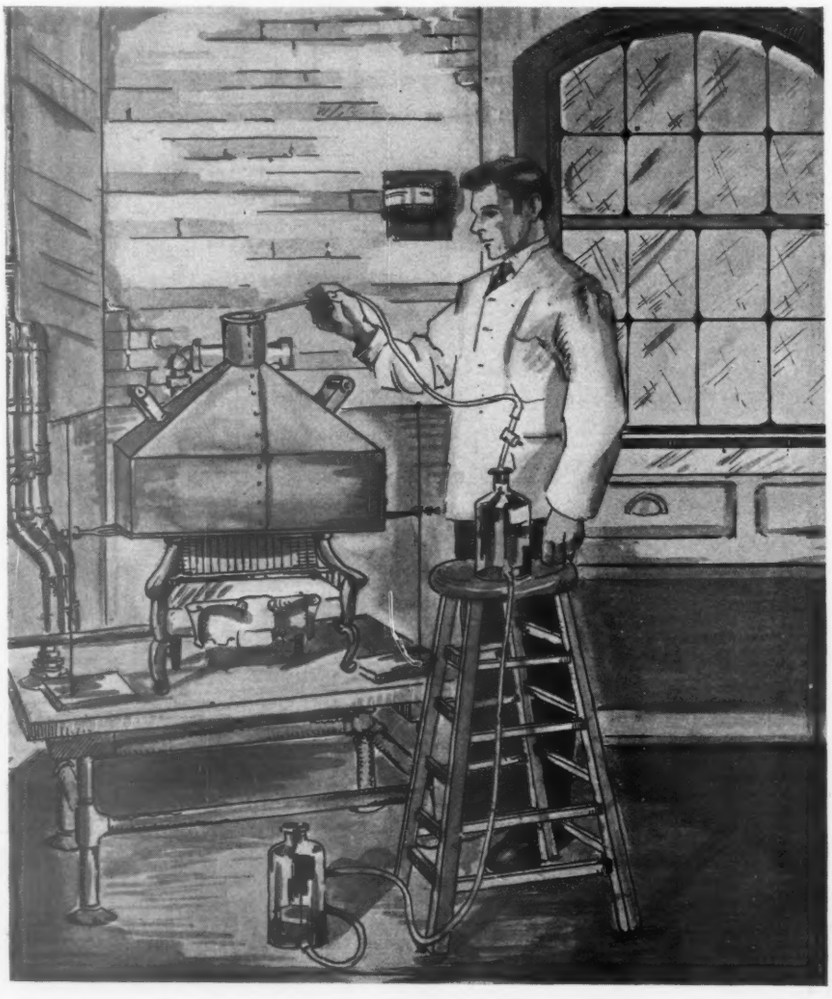
Director, A.G.A. Testing Laboratory

DURING the decade from 1890 to 1900, when the use of gas for domestic cooking and heating purposes began to gain widespread popularity, many manufacturing concerns entered this field and numerous new types of gas appliances made their appearance. The art of domestic gas utilization grew very rapidly, and it soon became evident that both consumers and producers of gas and gas appliances would be materially benefitted if comprehensive standards for gas appliance construction and performance could be developed. Shortly after the turn of the century, therefore, the gas industry instigated movements toward appliance development and self regulation in the public's interest by planning for the preparation of national standards of appliance safety and efficiency and for the establishment of some national agency for their enforcement.

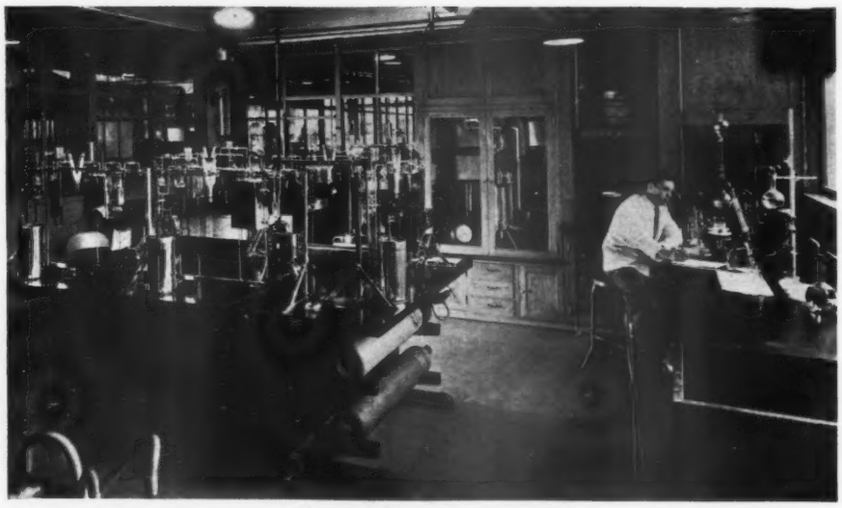
As early as 1903 specifications for gas ranges and certain other kinds of domestic equipment were developed by committees of the gas industry. These standards were improved from time to time, but were used merely as guides to appliance manufacturing and local utility companies. In 1915, however, the task of preparing a nationally acceptable Gas Safety Code, a manual setting forth the fundamental principles governing gas utilization, was undertaken jointly bv a committee representing the U. S. Bureau of Standards and two major associations of the gas industry later consolidated into the American Gas Association. In 1920, the work of completing the code was turned over to the American Engineering Standards Committee and in 1925 it was approved as a Tentative American Engineering Standard. Later it became an American Standard (1927) by the action of the American Standards Association. All of the various and now familiar sets of appliance, accessory, and installation requirements subsequently formulated by the American Gas Association and nationally adopted, have been prepared to conform to the principles of that Code.

Thus, in 1915, the gas industry began directing its efforts toward further safeguarding consumers' interests by clearing the way for the extensive present activities of the American Gas Association in (1) setting up nationally approved standards of appliance construction and performance, (2) testing new models of equipment for compliance therewith, and (3) certifying appliances for safety, reasonable efficiency, and convenient and substantial construction. In that year a committee headed by R. B. Harper, now Vice President of The Peoples Gas Light & Coke Company, Chicago, made definite recommendations and presented plans for establishing a national agency for the testing and certification of domestic gas appliances. Thus the plans in which Wm. J. Serrill, of the United Gas Improvement Company, and others, had been so deeply interested several years before, began to approach a reality.

Actual credit, however, for final arrangements concerning the foundation of the American Gas Association Testing Laboratory should go to a group, headed by H. C. Abell, former president of the American Gas Association, which was assigned



to this duty during the administration of President J. B. Klumpp. Other leaders active in the preparation of final plans were Col. Oscar H. Fogg, N. T. Sellman, the latter at that time connected with the Association's staff, and the late A. H. Hall, Vice President and General Manager of the Central Union Gas Company. There were numerous others outside the American Gas Association's own staff who played a most important part in the foundation of the above mentioned gas appliance testing and research establishment. Among these must be mentioned E. R. Weaver, chemist of the United States Bureau of Standards, and R. W. Gallagher, former president of the American Gas Association and the first chairman of the Laboratory Managing Committee.



Chemical Section, Cleveland Testing Laboratory.

As a result of the efforts of these men and through the cooperation of gas company and manufacturer members of the Association, the American Gas Association Testing Laboratory was established at Cleveland, Ohio, on June 1, 1925. It was intended that this institution should be devoted primarily to research and testing incident to the development and enforcement of the national standards of safe and efficient gas utilization so long sought by the leaders of the gas industry.

The growth of the Laboratory since its modest inception nine years ago has been most remarkable. When actual testing activities were first begun, part of the testing equipment required was obtained from member organizations and space was secured on the second floor of one of the buildings of No. 2 Plant of The East Ohio Gas Company. By 1927 the demands of the industry in the fields of testing and research had taxed the facilities of the Laboratory to the limit. The importance and value of this program not only to the public but to the gas industry was established beyond doubt. The necessity of acquiring larger quarters was evident; consequently, plans were made for the purchase of property and the erection of a modern laboratory building. Rapid progress was made in this endeavor through the cooperation of member companies with the result that in June, 1928, the new building was completed and equipped and operations transferred to it. At present, the Association operates two laboratories, one in Cleveland and the other in Los Angeles. The Cleveland Laboratory, property, and equipment are owned entirely by the American Gas Association, and represent an investment of approximately a half million dollars. In 1931 the Pacific Coast Branch was opened in a building leased at 718 Towne Avenue, Los Angeles, California. This laboratory is completely equipped for testing all types of domestic gas appliances similarly to the one in Cleveland.

In the first year of its existence the Laboratory tested and approved 13 different types ot flexible gas tubing and 668 separate models of gas ranges. The Laboratory has approved more than 23,000 models of domestic gas appliances by tests and inspection since it began operations in 1925. These include gas ranges, space heaters, water heaters, boilers, furnaces, unit heaters, clothes dryers, laundry stoves, ironers, hot plates, and incinerators. It is estimated that more than 90 per cent of the domestic gas appliances marketed at the present time bear the Laboratory Seal of Approval. These figures are mentioned primarily to indicate the extent to which the A.G.A. Testing Laboratory has become a vital part of the gas industry's operations.

The standards upon the basis of which tests for approval are conducted are comprehensive, authoritative, and nationally recognized. The organizations and institutions represented on the committee charged with the drafting of these standards as well as the scope of the procedure followed in the preparation of them, insure the protection of producers, consumers, and general interest groups which may in any way be affected. All requirements are prepared under the jurisdiction of a committee known as the A.G.A. Approval Requirements Committee which is also a Sectional Committee

Pacific Coast Staff of American Gas Association Testing Laboratory.

of the American Standards Association, Project Z21. The personnel of this group represents every interested health authority, governmental agency, trade association, technical society, directly or indirectly interested, as well as both producer and consumer organizations and interests. Those making up the committee include representatives from the U. S. Bureau of Standards, U. S. Bureau of Mines, U. S. Public Health Service, U. S. Bureau of Home Economics, American Home Economics Association, Master Plumbers' Association, Heating & Piping Contractors' National Association, American Institute of Architects, Factory Mutual Fire Insurance Companies, as well as numerous manufacturer and gas company representatives of the American Gas Association and Canadian Gas Association.

The initial preparation and revision of requirements is handled by sub-committees of the above mentioned group, composed equally of utility and gas appliance manufacturer representatives who are specialists in the field to which the requirements drafted by them pertain. There is one standing subcommittee for each type of appliance and its activities are continued from year to year. Before any requirement is submitted to the Approval Requirements Committee for final adoption it must have been submitted for comment to every interested member of the Association and reconsidered by the subcommittee in the light of such comments and criticisms as may have been received. After having been prepared upon this basis and approved by the Approval Requirements Committee, requirements are then submitted to the American Standards Association for approval as American Standards.

To date, specifications are available for the following types of appliances and accessories:

1. Gas Ranges
2. Gas Water Heaters
3. Space Heaters (including radiant circulators, and gas-steam radiators)
4. Central Heating Gas Appliances (including warm air furnaces, boilers, and floor furnaces)
5. Unit Heaters
6. Industrial Gas Boilers
7. Hot Plates and Laundry Stoves
8. Flexible Gas Tubing
9. Hotel and Restaurant Ranges
10. Private Garage Heaters
11. Clothes Dryers
12. Incinerators
13. Gas Heated Ironers
14. Draft Hoods
15. Gas Burner Valves
16. Gas Conversion Burners.

Requirements are in the process of preparation and will soon be available for:

1. Gas Refrigerators
2. Semi-Rigid Gas Tubing and Fittings
3. Water Heater, Gas Range, and Space Heater Thermostats
4. Domestic Gas Appliance Pressure Regulators
5. Relief and Automatic Gas Shut-Off Valves for Use on Water Heating Systems
6. Automatic Main Gas-Control Valves
7. Automatic Devices to Prevent Escape of Unburned Gas.

A symbol known as the Laboratory Seal of Approval has been designed and copyrighted by the American Gas Association and is applied to all gas appliances tested and found to comply with the approval requirements. No gas appliance is permitted to be merchandised bearing this Seal of Approval unless it has thus been tested and duly approved. Approval is granted only upon compliance in every detail with the requirements in effect at the time the appliance is tested. Standards for gas ranges alone require that such equipment meet over 250 separate specifications for construction, performance and operation before approval is granted. This is similarly true of other types of domestic appliances. Special symbols are provided for marking listed accessories and flexible gas tubing.

As an example of the thoroughness of the tests applied, attention is directed to one or two which may be of special interest. Every appliance is tested on three different and distinct test gases which are representative of all those supplied throughout the United States and Canada. The gas test pressures used cover a range from 50 per cent below the average distribution pressure to 50 per cent above it. Appliances are required to operate on these gases and over these ranges of pressures without incomplete combustion of the gas in any case. In other words, by setting up extreme conditions of performance in the tests applied, assurance is gained that appliances will operate even more satisfactorily when installed under normal service conditions. The many tests for completeness of combustion mentioned above are made in a room with a normal oxygen supply. Space heaters, however, are in addition tested in a 1,000 cubic foot air-tight room on each of the gases and over the ranges of pressures specified. These added tests on space or room heaters are applied as a further precaution to insure the safe performance of such appliances even against the carelessness of the user and conditions in which a heater might be operated in a small, tightly closed room. The most sensitive and accurate gas analysis equipment available, including the Iodine Pentoxide apparatus and the automatic CO Recorder, are used in those tests of combustion products (flue gases) designed to insure completeness of combustion. Other safety requirements applied involve rigid tests for gas leakage, fire hazard, explosion, burner operating characteristics such as ignition and

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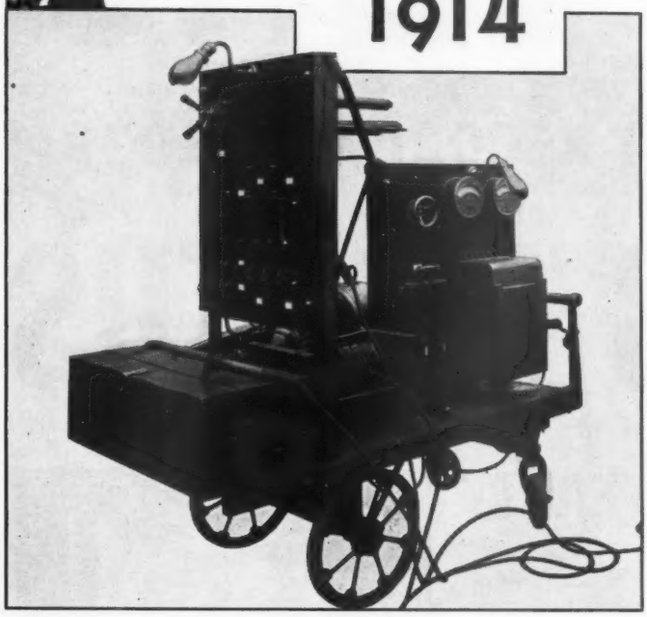
Cleveland Staff of American Gas Association Testing Laboratory.

Remember the Good Old Days, Lad, Back In 1914



What Good Old Days, Pop?... Let's Talk About 1934

"Don't try, Lad, to tell me about the early days of arc welding. 'Way back in 1914 Lincoln proved to me that arc welding could save us money—and save it we did by repairing worn and broken equipment with a Lincoln welder of that day. Nobody could beat us then on welding speed or quality of welds."

"And they couldn't today, Pop, if we had a new Lincoln *'Shield-Arc'* welder. It's as far advanced from the 1914 machine in performance as it is in appearance. Compare the quality and speed of welding done in your good old days and now—

	1914	1934
Tensile Strength (lbs. / sq. in.)	40,000	65,000
Ductility (% elongation in 2")	5-10	20-30
Fatigue Resistance (lbs. / sq. in.)	12,000	30,000
Impact Resistance (ft. lbs., Izod)	8-15	50-80
Density (grams / c. c.)	7.5	7.86
Corrosion Resistance	less than mild steel	more than mild steel
Speed of Welding	100%	150-300%

NEW IN WELDING
"Lincontrol"
—remote control without extra cables or portable accessories. Write for bulletin.

LINCOLN

Not only does the *'Shield-Arc'* welder produce better welds in less time, but it also costs less to operate. Before you buy any welding equipment find out how much Lincoln can save you."

W-72

THE LINCOLN ELECTRIC COMPANY, ***Largest Manufacturers of Arc Welding Equipment in the World,*** **CLEVELAND, OHIO**

"SHIELD-ARC" WELDERS AND ELECTRODES

TEXAS BEATS

OWN REFRIGERATION RECORD FOR 1933

IN FIRST 3 MONTHS

OF THIS YEAR!

TEXAS gas men are out to win a Blue Vase . . . and they don't mean maybe! During the first quarter of this fiscal year, January through March, they've rung up more Electrolux sales than during the whole of last year. And that's particularly significant because 1933 was a record-breaking year for these energetic Texans!

Every Employee a *Go-Getter!*

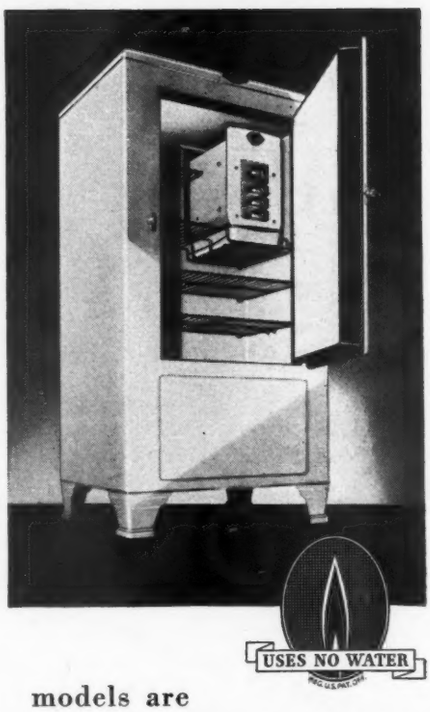
The new A. G. A. "Go Getter Campaign" presents a challenge that the employees of the Lone Star System don't intend to pass up. Every one of them—from meter-reader to president—has enlisted to help win the prize.

Extensive advertising promotion is also under way. And throughout the length and breadth of Texas, schools and sales meetings have been held regularly by every gas company since February first.

New Salesmen Taken On!

Nor is that all! Sales forces have been *enlarged.* In Dallas alone, sales personnel has been tripled. If you think these Lone Star boys are fooling when they say, "We're going to make this our biggest gas refrigeration year"—then you don't know Texas!

And they've got the product to do it with! The beautiful new 1934 Air-Cooled Electrolux



models are easier than ever to sell. They embody all those worthwhile modern conveniences every woman wants. Be sure your company doesn't miss the real opportunity presented this year to make the refrigerators in your territory *gas* refrigerators.

Electrolux Refrigerator Sales, Inc., Evansville, Indiana.

NEW *Air-Cooled* ELECTROLUX

THE SERVEL *Gas* REFRIGERATOR

Development of The Gas Refrigerator

By N. T. SELLMAN

Director of Sales and Utilization, Cons. Gas Co., New York

MANY people in the gas industry talked and thought about gas refrigeration for more than twenty years before a commercially acceptable appliance became available. The earliest attempts at gas refrigeration was for semi-commercial use. Several installations were made throughout the East as early as 1910 in butcher stores, dairies and other business places whose requirements did not exceed two to three tons of refrigerating capacity. These early machines were of the intermittent type, the entire generation of refrigerating effect for twenty-four hours of operating being accomplished in a two to three hour period. This, of course, meant that a high rate of gas consumption was necessary in order to do all of this work in such a relatively short period. It also meant that a large quantity of refrigerant was necessary in order to store up sufficient refrigerating effect during a two to three hour period to last for twenty-four hours. From a safety standpoint this meant two things: first, it required numerous safety devices to prevent over heating, building up of excessive pressure, the automatic cycling of gas on and off, the automatic cycling of cooling water on and off and, secondly, the large quantity of refrigerant represented a latent hazard in the event of leak. A few mishaps with this early type of machine soon brought forth local regulations prohibiting the use of heat in the form of flame in the proximity of refrigerating equipment containing more than a certain amount of refrigerant.

Intermittent Machine Experiments

Later on several attempts were made to design small intermittent machines for domestic use. From the standpoint of controls and valves these machines had all of the complications of the larger commercial machines. Through more frequent but shorter cycles the quantity of refrigerant required was materially reduced. However, in some municipalities these machines did not comply with the code requirements which had been laid down because of the earlier experiences. Only two machines of the intermittent type which came within the code requirements of New York City ever reached the point of marketable production.

This very brief review practically brings us up-to-date with the exception of what has transpired because of the introduction of the Electrolux Refrigerator, first as a possibility in 1925, and in 1927 as a commercial product manufactured in this country. Everyone is now sufficiently acquainted with the Electrolux Refrigerator to know that it is of the continuous type with all parts functioning in the same manner at all times. The steel unit is merely a hermetic housing serving as a container for the refrigerant. What controls are used are merely for producing uniformity in refrigerating effect and are in no sense there to aid in producing refrigeration. The Electrolux method of refrigeration was the invention of two Swedish technical students who chose absorption refrigeration as a subject for their graduating theses. The two men to whom this credit is due are Carl von Platen and George Munters.

The patent rights were acquired by the Electrolux A.B. of Stockholm, Sweden. Finally in 1926 the American rights were acquired by Servel Inc. The Swedish development of the Electrolux unit was, up to the time of its introduction to this country, electrically heated and all of the initial units displayed in this country were of relatively low capacity and equipped with electric heating elements. The possibility of applying gas heat to this unit was immediately apparent and even before Servel Inc. acquired the American rights, every effort was made to convince the Swedish interests that the development of this machine in America should be with gas as a source of heat and that, if this were done, they would have the unified support of the gas industry. Later on when Servel Inc. became the owners of the American rights, they were convinced from the very start that the major outlet for this unit in the United States should be as a Gas Refrigerator. In April 1926, at a meeting of the Eastern States Gas Conference at Philadelphia, I presented a paper where I outlined the requirements of what I then termed an ideal Automatic Gas Refrigerator. The points enumerated were as follows:

1—Any desired ice box temperature should be obtainable.
2—The desired temperature should be maintained uniformly or at least within a five degree variation plus and minus.
3—The machine should be absolutely safe under all conditions that may arise.
4—Operation should be continuous and free from manual supervision.
5—Operating cost should represent an economy over other types of refrigeration.
6—First cost should not be excessive.
7—Installation of unit should be simple and easily made.
8—Necessity for maintenance and repair should be negligible.
9—The machine should be of such design and dimensions that greater floor space would not be required than called for by present ice boxes of similar capacities.

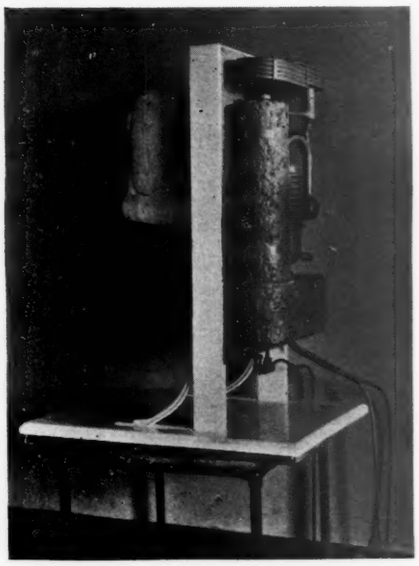
Another point of interest taken from this same paper is the following quotation:

Important Consideration

"The amount of heat absorbed by the cooling water in its flow in the jacket around the absorber and through the condenser is so slight that it prophesies but comparatively slight difficulty in redesigning this machine so that it could be made entirely air cooled. In the event that this is done and no connection is required other than gas, it would seem that the absolute ideal refrigerator had become available. Even as it is with the present water-cooled machine, no serious objection exists to the nine points enumerated, providing the cooling water temperature does not become too hot.

By the use of thermostatic control on either the gas or cooling water, it is possible to maintain absolutely constant ice box temperatures. Although we have only attempted to

control the gas consumption so far, it has developed that the quantity of heat absorbed by the cooling water has quicker action on the refrigerating effect, and is consequently a more logical medium to use for controlling the temperature."



One of the first American made commercial units.

The first American made units and cabinets were placed on the market during the early part of December, 1926. In the beginning there was only one model available. This was the EL-7 with side unit and cabinet of seven cubic foot capacity. As soon as the refrigerator was placed on display and a few modest announcements had appeared as to its availability we found that the most immediate interest came from professional people such as scientists, engineers, doctors, etc. The continuous cycle of operation appealed to these people from the standpoint of simplicity, safety and freedom from moving parts. Much encouragement as to the future possibilities for this type of refrigeration was acquired through the opinions of many such qualified people.

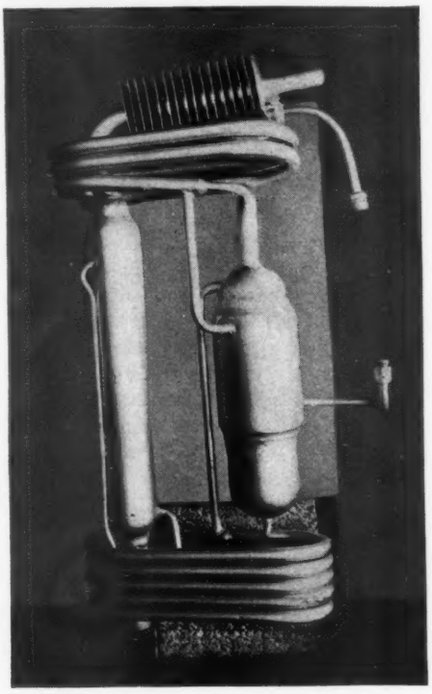
The first refrigerator was installed on the lines of the Consolidated Gas Company in March, 1927. This and the next few hundred sales and installations were made by engineers of the Utilization Department. It was felt necessary, before turning this new product over to the Sales Department, to take every precaution that these first sales and installations be made under the most favorable conditions. Later that year, when we felt that sufficient experience had been gained, we formed a separate division in our Sales Department known as the Refrigeration Division and its personnel consisted of trained specialty salesmen. The entire territory of the Consolidated and its Affiliated Gas Companies was divided into geographical territories and a retail salesman assigned to each. Wholesale salesmen were assigned to cover two or more of these districts and their efforts were further divided between new building business and tenanted building business. A liberal sales policy was adopted. In order to effectively compete for quantity apartment business attractive wholesale prices were established. To quickly sell the entire employee family of the company on the advantages of this class of business, refrigerators were sold to them at extremely low prices and on liberal installment terms.

Fortunately, because of the activities of electric refrigerator distributors the time was most opportune for the introduction of an acceptable gas refrigerator. Mechanical refrigeration was already well known to the average person. While the idea of mechanical refrigeration was acceptable to the public mind, it was generally the experience of those people who had purchased any of the earlier refrigerators that there was still much to be desired in the future development of the product. Coming into the market under such conditions the gas refrigerator, with no valves or moving parts, noiseless and extremely economical to operate, was bound to receive its share of recognition.

Smaller Appliance Needed

It soon became evident, however, that with only one model available, and that a seven cubic foot size, we were not in a position to compete for any large volume of apartment house business. The refrigerator was much too big and expensive to meet the requirements of the owners of small suite apartments. To fit into that picture at all it was necessary to supply a smaller and less expensive appliance, and preferably one that would take up the least possible floor space. Therefore, the next model was the low five cubic foot type available either with a table top or with a gas range on top; it being felt that if the refrigerator and the gas range could occupy the same space as is ordinarily required for the gas range alone, it would appeal to the apartment owner. This it did for a while but serious objections were received from users because of the necessity for stooping in order to see or reach the contents of the refrigerator. While it may seem that it was a mistake to design this type of a refrigerator it must be remembered that it has its place and is being sold today to meet space conditions in the extremely small kitchenette apartments in our territory.

For the entire year of 1927 the EL-7 and the low type five cubic foot box were the only two models available and sales were consequently somewhat limited. At the end of June 1928, fifteen months after the first refrigerator had been installed the first thousand boxes were operating. The development period had been very definitely passed. It was becoming easier to sell gas refrigerators. By the end of 1928 four additional models were available—the low type three cubic foot box, the upright four and five cubic foot boxes and the ten cubic foot box. This materially improved our competitive position in that we now had three sizes which were comparable with those sold in the greatest quantity by our competitors in the apartment house field. This is evidenced in that the installations for the year 1928 jumped to 3,221.



One of the first six refrigerating units purchased from A. B. Elektrolux, of Sweden, for test and development purposes by the Consolidated Gas Company of New York. It was received in Decemcember, 1925.

After the Utilization Department had made a sufficient number of installations to give us a fair idea of what the installation cost should be, arrangements were made to turn this work over to licensed plumbers. We felt that the plumber should be encouraged to speak well of this new product, and that they should be

placed in a position where it would be to their advantage to recommend gas refrigeration. To further this plumber interest we offered to pay in addition to the established installation price a bonus of $5.00 per refrigerator installed. This bonus was designed first to make it profitable for them to install refrigerators and second to make it possible for us to have a reasonable guarantee that the plumber would perform acceptable work, as the bonus was not paid until the installation was completed and had been passed on by a company inspector as being satisfactory. The value of this supervisory control on the company's part was particularly important in new building work, as in this case we had no opportunity to select the plumber—it being mandatory to use the plumber who already had the plumbing work in the building. Plumber dealers who had display facilities were encouraged to include the refrigerator in with their other display appliances. By these various arrangements it was possible to secure a reasonable amount of plumber cooperation from the very outset.

Apartment House Installations

By the early part of 1929 we had succeeded in selling several large apartment house installations, and our presence in the refrigeration field had now become quite well known among architects, builders, and owners. We now had a fairly complete line of refrigerators, and some minor downward price changes had taken place. Apartment house construction was going forward at a good pace. The acceptance of the gas refrigerator was beginning to become general. During the year 1929 we installed 14,471 refrigerators, most of them going into new buildings. There were some retail sales, but practically none to what might be called old apartment buildings which later were to become our biggest field.

Backing up the selling forces was a definite plan of advertising and education. The newspaper advertising was directed towards definite classes of our customers. Appeals were directed in separate advertisements to both the apartment house owner and the ultimate consumer. The low cost of operation was stressed in some copy, the long life expected of units in another advertisement, the quietness in another and safety in still others. Taken all together, the consumer advertising not only raised all of the important sales points, but also definitely assured the customer that the gas refrigerator was the ideal solution to their refrigeration problem. Direct mail folders were enclosed with gas bills. The sale of refrigerators to one owner was used as a wedge to sell other owners in the same section. Trade paper advertising in local real estate magazines even went to the extent of showing typical apartment kitchen layouts featuring the use of some of the models of gas refrigeration. This was particularly in the case of the combination range and refrigerator.

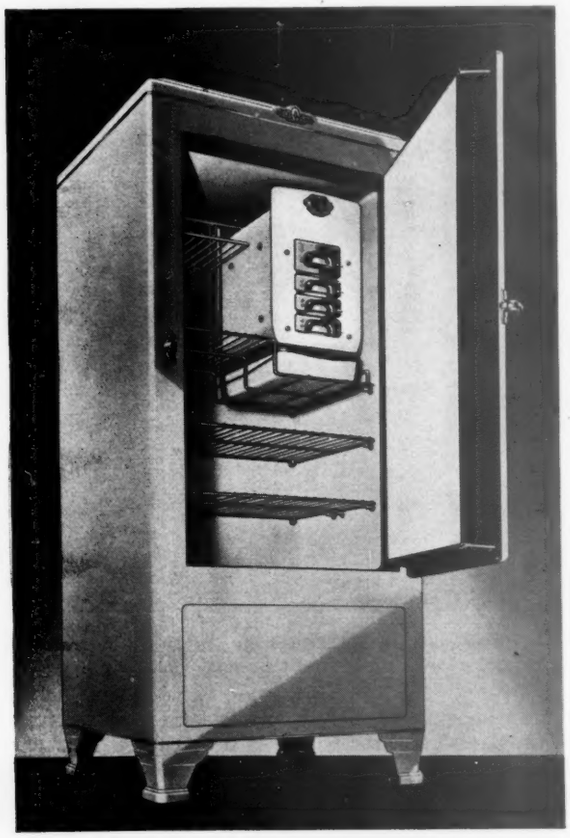
London Terrace, New York City, completely equipped with Electrolux Refrigerators. There are 1669 refrigerators installed in this building.

By 1930 it became evident that old buildings in order to compete in renting with new buildings had to make automatic refrigeration available. It developed that this field was so extensive that our wholesale sales division now had to be divided into two groups—one dealing exclusively with new building work thus contacting architects and builders, and the other group dealing only with owners and real estate concerns. The market was now extended to practically any apartment house where the rental was twenty dollars a room or better. 28,955 installations were made during the year 1930.

All of the nine points enumerated in the beginning of this article as requirements of a successful gas refrigerator had now been met. This was particularly true as it relates to point number five calling for low operating cost. The gas refrigerator was giving highly satisfactory refrigeration service for far less money than any other method of refrigeration including ice. This fact was becoming generally known by tenants of apartment dwellings, and in several cases where owners consulted tenants as to preference before purchasing, the gas refrigerator was chosen because of low operating cost. Desiring to take full advantage of this tenant demand, early in 1931 when 65,000 apartments had been equipped we issued a rental directory telling prospective tenants where apartments could be secured equipped with gas refrigeration. This action was very favorably received by owners who had installed refrigerators and prompted many of them to continue to so equip their buildings. Subsequently two other such directories were issued—one when installations had reached 100,000 and another when 140,000 apartments had been equipped.

The peak of refrigeration sales was

reached in 1931 when 47,536 installations were made. New building sales amounted to approximately 27% of our sales during this year, old building sales representing about 63% and retail sales about 10%. These percentages may raise the question of "why so few retail sales?" The percentage of retail sales follows very closely the ratio of our possible market for this class of business. In other words approximately 10% of our customers are what might be termed possible retail or individual purchasers of refrigerators, the balance of our population living in apartment houses where the owner is or eventually will be furnishing refrigeration.



A 6 cu. ft. Electrolux produced in 1934.

The year 1932 brought forth many changes in the refrigeration field. With the falling off in construction of new apartment houses the competition for the old or tenanted buildings became more and more acute. Many more makes of electric refrigerators were now on the market and some of them selling at extremely low prices. The real estate situation was rapidly becoming more complex; families were doubling up with consequent vacancies increasing at a rapid pace. Ownership of apartment buildings were passing from individuals to banks and mortgage companies with a consequent reduction in the stability of this class of business. Gas refrigerator sales during this years decreased to 33,806.

These rapidly changing conditions brought about by our present economic situation made it evident that increased supervision on the district, together with a more systematic coverage of the territory was necessary. To more effectively meet these conditions certain changes in our organization were made at the beginning of 1933. These changes consisted of combining our Domestic and Refrigeration Divisions and, to further segregate our wholesale and retail organization into two sub-divisions. A Domestic salesmanager heads the combined division. Two assistant managers were appointed—one to devote all of his time to the wholesale selling of ranges and refrigerators, and the other to devote all to domestic appliances. The entire territory, previously covered by salesmen working out of nine district offices, was divided into three units. The object of dividing the territory into lesser units was—first, to cut down the travelling time of salesmen which is naturally an important consideration in an extremely congested area such as ours—and second, to obtain the advantage of closer supervision of the territory by concentrating the sales direction from three centrally located offices. In each of these unit offices there are two supervisors, one responsible for wholesale sales, and the other for retail sales. The duties of the supervisors are to assist the salesmen on the district to close difficult sales and to be in constant touch with our more important customers. Since this change in our organization it is interesting to note that with the exception of a single month during the year 1933 our refrigeration sales retail showed a fairly substantial increase.

The three unit offices are operated exclusively for outside selling. The inside or floor sales people are under the jurisdiction of a showroom manager who devotes all of his time to the education and supervision of our floor personnel.

During the introductory stages it was felt and I believed justified from the results obtained that specialty refrigeration salesmen were required to handle this business. With the high degree of public acceptance of gas refrigeration and the greatly broadened field in the lower rental class of apartment buildings the need for continuing with the out and out specialty salesmen was not as pronounced as it had been in the beginning. With the combining of our Domestic and Refrigeration Divisions, therefore, all of our salesmen now sell refrigerators in addition to all other domestic appliances.

As mentioned before mortgage companies, banks and insurance companies have taken over several thousand apartment house buildings in our territory. This has materially affected our wholesale business. The properties taken over are either on a rental assignment basis or the property is acquired outright. This, of course, means that a large percentage of our wholesale business comes from these financial institutions. In order to properiy deal with these customers we have at the present time one man who spends all of his time and three men who spend part of their time calling on this class of customers. The many ramifications connected with foreclosures, transfers and assignment of rentals make it imperative to have trained men for this work.

Enter the Air-Cooled Unit

The most far-reaching and important development in the refrigeration field took place early in 1933. The long dreamt of and hoped for air cooled gas refrigerator was now a reality. Through our laboratory, a few isolated trial installations were made in the latter part of 1932. The results obtained with these early models convinced us that this new product more than lived up to all of our expectations. This new refrigerator was a marked step in advance over the water cooled refrigerator. The water situation had always been somewhat troublesome, particularly a few years back when there was a distinct water shortage over several months and the water situation received a great deal of publicity. Furthermore from time to time there had been considerable talk about increasing water rates. This actually became a reality at the beginning of this year when water rates were increased 50% as a temporary emergency measure.

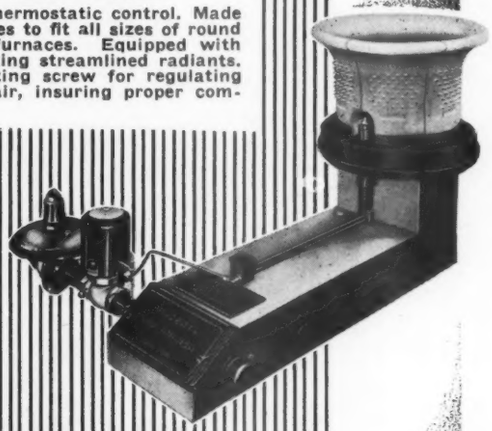
We now have slightly more than 16,000 air cooled gas refrigerators in service. The history cards of these refrigerators indicate that the sav-

(Continued on page 141)

...and now Streamline Radiants

STANDARD BURNER

Complete thermostatic control. Made in three sizes to fit all sizes of round boilers or furnaces. Equipped with self-supporting streamlined radiants. New adjusting screw for regulating supply of air, insuring proper combustion.

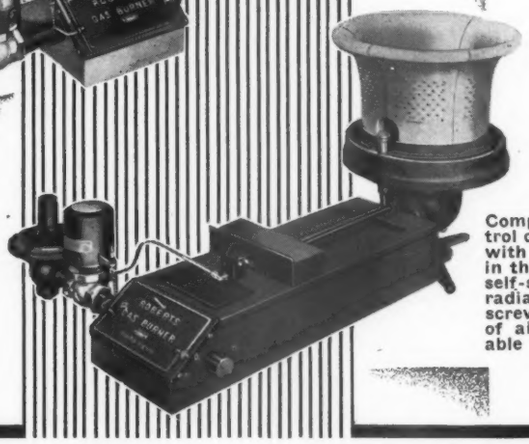


RECTANGULAR BURNER

Made in three standard sizes:

Dimensions of Burner	For Grate Dimensions
SR 1017	12″ to 18″ W by 19″ to 25″ D
SR 1222	13″ to 22″ W by 23″ to 33″ D
SR 1828	20″ to 30″ W by 29″ to 39″ D

Other sizes made to specifications. Equipped with self-supporting streamlined radiants. New adjusting screw for regulating supply of air and new Iris adjustable type orifice.



G TYPE BURNER

Complete thermostatic control or remote manual control with automatic pilot. Made in three sizes. Equipped with self-supporting streamlined radiants. New adjusting screw for regulating supply of air and new Iris adjustable type orifice.

Streamlined Self-supporting Radiants are now standard equipment on all Roberts-Gordon Conversion Burners. These Radiants deflect the heat to the sides of the fire pot and cause the flame to impinge against the walls insuring low stack losses and maximum economy.

Roberts-Gordon engineers point with pride to our new Iris adjustable orifice which, with a slight movement of a conveniently located and yet hidden arm, can change the gas adjustment as required. The new Streamlined Radiants simplify and cut installation costs. They are supported in a channel in the burner head and will not move out of place after installation. Only six radiants are required as compared to from twelve to twenty of the leaning type.

The Roberts-Gordon complete line offers Controlled Gas Heating Units for heating the smallest home of the largest commercial building. Our conveniently located warehouse stocks assure prompt shipments.

ROBERTS-GORDON APPLIANCE CORPORATION

BUFFALO, NEW YORK

Home Service Fifty-Five Years Ago and Today

By A. M. GLEASON

Secretary, American Gas Journal

ALTHOUGH Home Service, as now recognized by the gas industry, is comparatively new, old records disclose the fact that former gas executives realized the value of cooking demonstrations as a means of educating housewives on the proper use of domestic gas appliances.

In 1879 the managers of various gas co npanies in the City of Brooklyn, New York, united in an arrangement to secure the services of Miss M. S. Dodd, a graduate of Kensington Museum, England, to give a series of free public lectures. According to references made to these demontrations, taken from the April 16, 1879 issue of the *American Gas Journal*, the lectures were "eminently successful, being well attended, replete with interest and at the same time giving to many people, who would not otherwise be reached, a knowledge of the practical advantages of gas for domestic purposes other than those of illumination. The result is a very large inquiry for information as to the use of gas stoves for cooking."

Again in March, 1891, the following item appears in the *Journal*: "The proprietors of the Altoona (Pa.) Gas Company have good reason to congratulate themselves on the good results that followed their enterprise in engaging Mrs. Rorer—of cook book fame—to deliver a series of lectures to the residents on the value and convenience of gas stoves for cooking, etc. The lectures were largely attended."

Early Home Calls

Educational work on the use of gas for cooking was conducted in New Jersey in 1897-1898 by Mr. Philmer Eves, who was at that time sales supervisor in the commercial office of the Paterson and Passaic Gas and Electric Company at Paterson, a predecessor of the Public

Service Electric and Gas Company of Newark. The work as done by the sales representatives who were taught the art of gas cookery by a Mrs. L. M. Ludlum, a well known cook. Later several women were employed as demonstrators. These women were good cooks and they were sent to the homes of customers when gas ranges were installed, to give instructions on lighting the oven and how to maintain a moderate, a slow or a hot oven. They usually gave a practical demonstration by baking a pan of biscuits.

About this same time Mrs. Ludlum was commissioned by the Philadelphia Gas Works of Philadelphia, Pa., to visit all outside holdings of that company at more or less regular intervals for the purpose of conducting cooking demonstrations. Five years later the infant organization required another member from the new business department to assist Mrs. Ludlum with her demonstrations.

Thirty-three years ago a Home Service "Bureau" was started by the late William Judson Clark, Vice-President of the Westchester Lighting Company, who was the first sales manager of the Consolidated Gas Company of New York. In May, 1901, Mr. Clark employed and trained a corps of ten women familiar with the art of domestic cookery, and sent them forth among customers as demonstrators of the proper operation and utility of gas ranges.

At first these demonstrators confined their efforts to instructing the woman of the home in the mechanical operation of her gas range, but gradually this service was extended to instructions in the preparation of foods. Many other domestic gas appliances also were added to the company's sales service from time to time, instruction on the use of which was best rendered in the homes where they were installed. The pioneer demonstrators strove earnestly to keep abreast of these developments and succeeded in a manner comparable to the achievements of their fellow pioneers in all the other phases of gas fuel service.

Departments Organized

Demonstrations of this kind, and similar services offered by food and appliance companies proved so valuable in building good will and increased gas consumption that several other gas companies organized departments devoted especially to this work.

The Brooklyn Union Gas Company of Brooklyn, New York, was among the first to establish a Home Service Department. This was in 1908. The department operated on a small scale until 1915, when under the direction of Miss Dorothy Buckley, a large space in the main building was given over to the reception rooms and auditorium, and a staff of about eight people was assembled. The following item from the May 29, 1916, issue of the *Journal* gives a very good idea of the success of this department from the start:

"Since the opening of the Domestic Science School in their new quarters the 1st of February, 1915, there has

been a total audience of 55,532 women, 11,645 enrollments and 6,373 certificates were issued."

In Philadelphia as the demonstrations grew in popularity, the management decided in 1910 to organize an independent cooking instruction department with a greatly increased personnel.

The number of instructors in each group was increased in 1911 to twenty and remained thus until the entire department came under the direction of Mrs. Ludlum a year later as a result of the resignation of Mrs. Carrowl.

In 1911, Miss Mary E. Dillon, then office manager of the Brooklyn Borough Gas Co., Coney Island, New York, and now president of the company, realizing that there was a large potential market for gas, employed Miss K. S. Mulhern to survey their territory, of approximately 7,200 active meters. During the spring, summer and fall Miss Mulhern called on every customer on the company lines. Being a good cook and a fair mechanic, she conducted an educational campaign and made many minor adjustments on customers' appliances while counting the ranges, water-heaters and so forth then in use. The resulting increase in range sales was most gratifying to the company. The following spring the company opened a new district office, featuring among other things a model kitchen. Miss Mulhern was made manager of this new district office.

In 1915 the Public Service Electric and Gas Company of Newark, New Jersey, decided to assign a professionally trained woman to carry on the work started by Mr. Eves and Miss Ada Bessie Swann, a graduate of the Boston School of Domestic Science, was assigned to the Plainfield commercial office of the company to advise women on food preparation, cooking and other homemaking problems.

Gathering of Housewives for a Home Service Lecture and Demonstration at Brooklyn Union Gas Company, 1916.

Mrs. Ludlum was made chief instructor of the department and placed in charge of a group of ten instructors with headquarters in the company's office at 1706 North Broad St. A similar group was stationed in the downtown office of the company at 11th & Market Sts., under the supervision of Mrs. A. A. Carrowl.

The duties of these instructors were to follow up all sales of gas ranges, to instruct customers in the proper use of their new appliances and to assist them, if possible, with their cooking problems. The instructors were also required to make house-to-house calls in their respective districts with a view to maintaining friendly customers relations. The instructors were not directly responsible for sales but leads which they supplied to regular salesmen frequently resulted in sales.

Coal ranges, at this time, were used to a considerable extent for heating as well as cooking and in many homes the gas range was disconnected during the winter as a means of economizing. It was part of each instructor's job, therefore, to help educate customers to the advantage of cooking with gas the year around. The instructors were also frequently called upon for information regarding the use of gas for illumination.

A New Era

After the World War, several departments which previously had been suspended were resumed and 1919 started a new era in Home Service.

The gas companies in the Ohio vicinity were faced with a shortage of natural gas in 1919, and the East Ohio Gas Company of Cleveland employed Mrs. Luella M. Fisher, who had previously made a very thorough study of the gas situation, to assist them in educating their consumers in

New York Consolidated holds a Cooking Demonstration in 1910; Sign in Upper Right Corner in Four Languages.

gas conservation. She addressed domestic science classes in the College for Women of Western Reserve University, entire teaching staffs of domestic science classes in high schools and also women's clubs on the proper uses of gas appliances. Her duties also included answering complaints from consumers. This was the beginning of Home Service in Cleveland and Mrs. Fisher's association with the gas industry.

A few years later as Home Service director of the Erie Stove and Manufacturing Company of Erie, Pa., Mrs. Fisher travelled throughout the United States giving lectures and demonstrations to high schools and colleges and groups of women in co-operation with gas companies. The organization of several Home Service departments can be credited to her good work.

The year 1922 is an important one in the history of Home Service as it was in that year the value of Home Service was officially brought before the American Gas Association.

Mrs. Anna J. Peterson, Home Service director of the Peoples Gas Light and Coke Company of Chicago, gave an address before the commercial section of the A.G.A. in Atlantic City entitled "Teaching Women to Cook Helps Gas Sales." Her talk depicted the work done by her department, which was organized in March of that year. Each morning during the convention Mrs. Peterson also gave cooking demonstrations which were largely attended by the lady visitors to the convention.

In addition to this, Mr. Philmer Eves, then advertising manager of the New Haven (Conn.) Gas Light Company, was appointed chairman of the sub-committee of the American Gas Association called the Home Economics Service Bureau. The duty of this committee was to make a study of home economics work as it was being done throughout the gas companies.

Exterior "Demonstration Coach" or "Travelling Kitchen" Philadelphia Gas Works, 1934.

At the A.G.A. Convention in 1923 Mr. Eves delivered his report on Home Service activities which included the results of a questionnaire sent to gas companies. Fourteen gas companies then had home economics departments in operation, thirty-one companies indicated an intention to establish a department and thirty-nine were interested. Mr. Eves recommended that the Home Economics Service Committee should continue to function and proposed to the managing Committee of the Commercial Section that they appoint as chairman of this committee for 1923 a Home Service director in the work. The Commercial section indorsed his recommendation to appoint Miss Ada Bessie Swann of the Public Service Electric and Gas Company of Newark, N. J.

The first committee was composed of representatives from the following companies who then had Home Service departments:

New Haven Gas Light Company, New Haven, Conn.
Laclede Gas Light and Coke Co., St. Louis, Mo.
Brooklyn Borough Gas Co., Coney Island, N. Y.
East Ohio Gas Co., Cleveland, Ohio.
Georgia Railway Light & Power Co., Atlanta, Ga.
Public Service Elec. & Gas Co., Newark, N. J.
Peoples Gas Light & Coke Co. of Chicago, Ill.

Home Service progressed rapidly in the gas industry through the efforts of this committee and in 1926 Miss A. Deane Dowell was appointed A.G.A. Home Service counsellor. Under her direction the activities of the Home Service Committee broadened. Summer courses for Home Service workers were started in 1926 in Teachers College, Columbia University, New York, and in 1929 a short course was established at the Testing Laboratory of the American Gas Association at Cleveland, Ohio. Both of these courses proved of value in acquainting Home Service directors with the mechanical operations of the various gas appliances.

In August, 1929, Miss Jessie McQueen, a food and nutrition specialist of Montana State College, was appointed A.G.A. Home Service counsellor, upon the resignation of Miss Dowell, and has served in that capacity since.

THE PEOPLES GAS LIGHT & COKE CO.
FREE COOKING
LECTURE-DEMONSTRATIONS
EVERY TUESDAY & THURSDAY AT 2 P.M.
AT OUR NEIGHBORHOOD STORE
1520 MILWAUKEE AVE.
HOME SERVICE DEPARTMENT
THE PEOPLES GAS LIGHT & COKE CO.
FREE COOKING LECTURE DEMONSTRATIONS
HOME SERVICE DEPARTMENT • THE PEOPLES GAS LIGHT & COKE CO.

Demonstration Truck used by The Peoples Gas Light & Coke Company, Chicago, in 1923

(Continued on page 155)

The Gas Show Window—A Youngster That Matured Rapidly

By RAY MARTIN

Director of Display, Consolidated Gas Company of New York

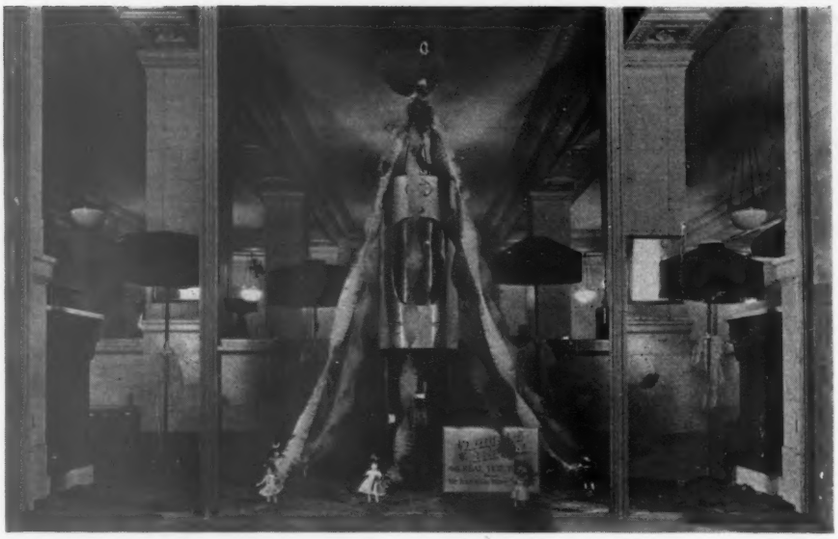
Above—Northern Union Gas Company, New York, Windows in 1900.

Left—Standard Gas Light Company, New York, Window in 1907.

WHEN pavements supplanted dirt roads and wooden shoes were replaced with leather show windows were predestined to become a forceful advertising medium. But it is hardly necessary to go back so far. Witness, for example, a New York City gas office as recently as 1900. Utility company window display was unknown. After all, weren't windows intended for light? If folks wanted to rent or buy a hot plate or cooker—they should know enough to go in and order it. Fortunately, some did, but by 1907 the impression developed that it might be better salesmanship to construct larger windows through which the actual appliances could be seen. An era of increased sales and rentals followed the introduction of actual show windows. Just what portion of the increase can be attributed to these early window efforts is very much a matter of conjecture, but increases there were and window displays consisting of nothing more than appliances and price cards got some of the credit. Therefore, the practice of filling windows with unrelated merchandise continued.

As recently as 1920 the accepted gas company window display still boasted a miscellaneous assortment of appliances and placards on the assumption we presume that enough people would look and read to justify the porter's labors. In reality, few passersby actually stopped because such windows were dull and unin-

viting. In some cases the plate glass itself frequently needed cleaning. This curious condition was not necessarily the result of inertia. A few of the more progressive companies tried artificial flowers, decorative screens—even cloth draperies, but the gas range or water heater still aroused about as much "parlor ornament" interest as a percolator on a mantelpiece. The window shopper of 1920, for example, was confronted with water heaters used as May poles and many other rather questionable attempts at sales stimulation. It was one thing for a gas company to even want to advertise in its show windows and quite another to find a way to do it. As a result, and in the light of present practice, most show windows were just mishandled.



New York Consolidated makes use of the Maypole Principle to Decorate Water Heater, 1920.

In 1921 a revolutionary thing happened. The Chicago Gas Company enclosed the first of its Michigan Avenue show windows. Permanent backs and roofs were built in—but the gas range still appeared with a bunch of roses and puffed cloth. These window displays undoubtedly represented a definite advance. They were nice to look at but still lacked any advertising appeal. However, it was a beginning. It was, according to the best information available, the first time that utility company show windows were considered as an actual advertising medium. Gradually, it became apparent that utility companies must create a definite type of window advertising suitable to their own needs if their windows were to return a profit. Consequently, that all-embrasive organization known as a Display Department was born. The result, after some research and experiment, was an entirely new type of window display that at first resembled a hybrid born of showmanship and periodical advertising. The first displays of this new order produced in 1923, were rather crude. For example, a hand-lettered card and a cut-out Dutch girl looking at the latest in gas lighting was accepted as sales inspiring. However, the creation of a new advertising medium was in progress. Allowances were generously made. Steady development followed, resulting, in 1927, in such advertising as "They're not parlor ornaments." Many faults are now self-evident in this particular display, but only seven years ago it was sufficiently well reggarded to inspire the use of similar window displays by an increasing number of gas companies. It represented another milestone in the development of window advertising.

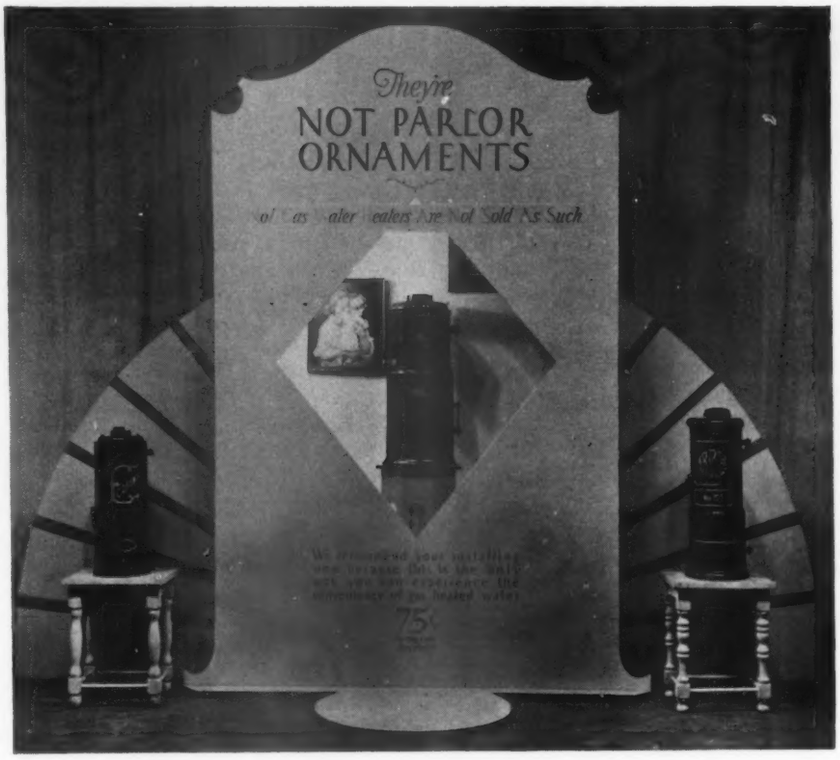
The Window Trim of 1923 Shows Growth.

Since 1927 we have witnessed tremendous strides in display advertising at least comparable to contemporary development in all other advertising media. The lettering, art, and conception that go to make up today's effective window display have been considerably improved, but they are nothing more than the development of the trail blazing Dutch girl of 1923.

Today's Display Department knows more about showmanship; it knows more about advertising and advertising psychology; it knows more about color psychology and a host of other technical things, but it must have the opportunity to apply such knowledge if the development of show window advertising is to continue. The utility companies that have given display advertising a legitimate trial now regard it as not only an effective promotional force, but as the most effective advertising per dollar invested.

Further development of window advertising is also a matter of conjecture. The future undoubtedly holds many new things, but in the meantime we can contrast today's methods — including appliance-less water heater and furnace displays—with the probable reactions of a contemporary window shopper viewing the windows of a gas company treated in the 1907 tradition. If she stops at all she probably sees a gas range. She realizes that it's nice looking, done in rather harmonious colors, but what of it? Hers is black but it till cooks. A tall cylindrical tank, perhaps painted green, reminds her of her hot water boiler at home. A card alongside says something to

the effect that it's an automatic water heater. A white refrigerator — "Isn't that funny — when did the Gas Company start to carry Frigidaire?" There are other cards in the window, but she has neither time —nor inclination— to read them. She passes on to other windows—more interesting windows. She did not realize that the gas range she saw was equipped with an oven heat regulator and an insulated oven. She could hardly be expected to visualize the immediate hot water supply that would always be hers if she bought the automatic gas water heater, because there was nothing to assist her in forming a mental picture. The statement that ice was made by a gas flame seemed too ridiculous to believe.



This is probably what would happen if gas company windows reverted to their original function of merely showing appliances. But moving backwards needs no further consideration. Show windows today have a definite place in the advertising program of the gas industry. Their job is to create interest in the comfort and convenience that is

(Cont. on page 157)

Above—A Window Trim by Ray Martin for New York Consolidated in 1927.

Below—One of Martin's Latest Efforts for New York Consolidated.

The Story of Air Conditioning

By A. M. APMANN

THE FIRST methods of heating served a part of the needs of air conditioning, and to those in the northern climates gave added benefits for the greatest comfort needs. However, the methods and equipment—open fires in tents and shacks, a roaring fire room in the center of the monastery or even the Franklin stove—can only be classed as partially adequate. The portions of the body towards the fire roasted and those away froze.

In 1848 Elsner developed an almost non-luminous gas burner for cooking purposes. The fate of this burner can best be stated by noting that the housewives were not entirely satisfied with it; it ended as a heating stove for churches. After it had "proved" itself in the Berlin Cathedral, it was also adopted for heating St. Catherine's Church in Hamburg. However, this particular piece of equipment does not seem to have created great interest in gas, and next came the combination coal and gas grates in warm air furnaces in the natural gas regions. Then soon followed gas designed furnaces of cast iron and sheet steel construction. The cleanliness of gas fuel can scarcely be set down as satisfying the 5th factor of year-round air conditioning as defined by E. D. Milener[1]:

1—Heating.
2—Humidifying.
3—Cooling.
4—Dehumidifying.
5—Cleaning.
6—Circulating.

During this period the furnace equipment for solid fuels was sorely beset by radiated heat with the subsequent foundation at the University of Illinois of a research program extending over many years.

About the time of the World War some few gas companies actually began to supply complete winter air conditioning installations. Many were nothing more than glorified Elsner burner installations with forced circulation, humidification and a modification of a sawdust catcher. The results were astonishing, however, and all homes on or near gas lines now became prospects for gas heat, for the gas fired boiler had been a stable article of commerce since before 1905.

In the middle of the last decade, the development of the automatic furnace fan and the exploitation by its inventor gave forced air heating a great impetus and gradually improvements were introduced so that mechanical circulation proceeded even if gingerly. About this time (1927-1928) we were cajoled into theatres with the promise of "20 degrees cooler inside" and most of us froze going in and sweltered on our way out. The mechanical cooling systems were installed "not too wisely but too well," so that air conditioning (cooling) lost much ground. These installations also served to focus attention on certain features of cooling comfort too lightly considered previously. The Committee on Industrial Gas Research, who were carrying on a number of projects of gas research and development, were charged with the supervision of the project of creating suitable gas fired equipment for year-round air conditioning. A review of their annual reports shows clearly that they were headed in the right direction.

The use of gas for air conditioning has almost equal antiquity with the conflict between the priests of Baal and Elijah for the following

[1] *Paper delivered at A.S.R.E. Meeting, January,* 1932.

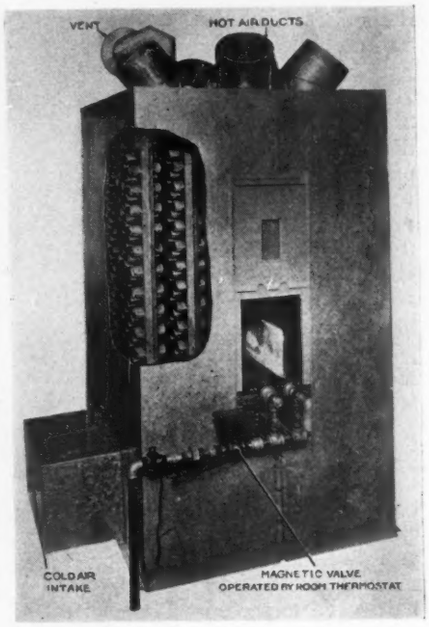


Fig. 1—Portland Gas & Coke Company Gravity furnace developed in 1915 employing Vento cast-iron radiation. This furnace was exclusively used by the Portland Gas & Coke Company until 1921 when a new type of cast-iron radiation was developed. At the same time sheet-steel radiation was developed as an alternative to the cast-iron, which latter idea became more popular on account of lower selling price. Many of these installations had forced air circulation, automatic humidification, various types of dust catchers and air washers.

Fig. 2—A glorified Rector System of 1916 wherein forced circulation, humidification, and dust catcher was employed, all automatically controlled. Vento radiation used for heating surface. Individual thermostatic room control. The magnetic valves controlling the burners were also connected with the room register. Closing the floor register would automatically shut off the burner supplying heat to the particular room.

of the people; we read that in the construction of the oracle of Apollo at Delphi[2] the divisions of the interior were the pronaon . . . "the cella, where a perpetual gas fire burned on the hearth, and where was placed the amphalos . . . and the adytum, where the oracles were delivered." Within the latter "and over a deep chasm issued a peculiar mephitic vapor, where the Pythia delivered its revelations." Here it is —the original connection between gas, heating and conditioning.

Then came the various Dark, Middle and more modern Ages down to Murdock when gas became an industry and not an intoxicant to the priestess of Apollo. Practically everyone knows the story of the industry from that point on.

Originally intended for illumination of homes and streets, gas gradually became a factor for cooking in the period after the Civil War. To be sure, the appliances were quite different in appearance and results from the completely automatic range of 1934 but a step away from a single confining activity had been taken and the gas industry embarked along the correct and most desirable course, that of heating.

An Idea Still Dormant

But air conditioning was still something to be coined. About the end of the 19th century a few water heater manufacturers first proposed the use of the larger units for house heating purposes, but it is really difficult to fix exactly the date of the first gas fired furnace jobs. However, it is probable that the earliest warm air installations were private and antedated the turn of the century. This omits the portable and fixed room heaters of the porcelain bowl, reflector and other types and the previously mentioned Elsner heater. About 1905 a unit type of gas fired warm air furnace became commercially available, but was restricted to the natural gas districts. It was distinctly better than the combination grate coal and gas furnaces. This change was one of mere substitution of one fuel for another and produced little if anything to the progress of air conditioning.

The real beginning of an organized plan for warm air heating came in 1911 when the Portland Gas & Coke Company cut the gas rate to 50 cents per M cu. ft. for house heating purposes. For the first few years the only systems installed were gravity systems, but about 1915 the first truly winter air conditioning units were put in operation. The gravity unit in use at that time is shown in Fig. 1. This furnace, in use from 1915 to 1921, consisted of Vento cast iron radiator sections, drilled pipe burners, magnetic gas valve and insulated sheet metal jackets. The cast iron sections had a very great radiating surface which gave very efficient heat transfer and uniform distribution and air flow among the outlets. Fig. 2 shows an installation of this type made in 1916 in a large home which also included forced circulation, humidification by means of an automatic float feed, and a dust catcher. The burners were operated by individual room thermostats with the magnetic valves for each burner being controlled by the flow register, so that the magnetic valve could not open if the register was closed. This unit also had the fan and humidifier under automatic control, so that it can be readily claimed that here is, if not the earliest, at least one of the first half dozen complete winter gas fired conditioning jobs. Meanwhile, manufacturers of gas appliances became interested in that vast 53 per cent of the country's homes using warm air heat, and many designs were produced.

One of the earliest of these furnaces, which was widely distributed in natural gas belts, consisted of relatively large size sheet metal radiators with air passages around and between the vertical passes of the furnace. Good operating efficiencies were obtained by careful proportioning of the radiators, heating surface and flue passage. A reverse flue aided materially in producing this efficiency. The value of this design is evident when it is found that even today this unit continues as one of the leaders.

First Humidification

Humidification was first produced by manually filled pans. Later automatic float feed pans and thermostatically controlled water valves served to maintain proper pan levels. About 1926 Armbrusted designed an appliance chiefly for humidification. Water from a small orifice was directed against a porcelain plate. The velocity of impact virtually atomized the water which was completed by passage of the moisture laden air over a large heating surface. Unfortunately, the development was ahead of the market, so that the many advantages were not sufficient to overcome lack of interest plus the very few weaknesses.

A separate gas heated humidifier was then entirely forgotten until the past year, when a very efficient and compact evaporative type was built. This unit is now available for completely automatic action.

Early in the twenties a new force came into the field—the automatic furnace fan. Fans or blowers had always been like gas fired equipment —ON or OFF. This method of operation brought about serious operating deficiencies as well as unnecessarily higher operating costs. It remained for J. C. Miles to solve this problem by the use of extremely light but unbalanced louvres in parallel with the fan. With the fan stopped, the louvres, because of unbalanced weight, opened by gravity. As soon as the fan started the air pressure created in the air passages of the furnace closed the louvres until the fan should again stop. The result was the full delivery of air through the furnace both with the fan in operation or when stopped.

Fuel Savings

Savings in fuel depended on the excellence of the system, and ranged from 15 per cent for the well laid out system up to 40 per cent for the poorly equipped home. A champion of a cause like this could not fail to have a great influence and we find that in 1930 at least 50 per cent of the gas fired furnaces were supplied with blowers, filters and automatic humidifiers. The final step in winter air conditioning was taken by the Bryant Heater & Mfg. Co., with the introduction of the Dualator. This appliance has many distinctive features previously available only for larger buildings. The basis is a steam boiler, so that steam or vapor is available for those portions of a building in which radiated heat is desirable for installation or other reasons. Filtered air blown over a humidifier and through a fin type indirect radiator becomes moistened and warmed. This conditioned air is then circulated to the desired locations. Automatic temperature control provides for independent operation of either radiated heat or conditioned air if necessary.

Experience of the users over several winters has shown the value of this type of heating for close accurate control of home conditions, and general comfort of the occupants. But excellent as these units are, the year-round answer still remained unsolved.

Attempts had been made by many manufacturers of furnace equipment to combine a furnace, with its fan, filters and humidifier, with electrical refrigeration units. The economic difficulties of 1930-34 have unfortu-

[2] *The American Encyclopedia*, 1881, *V.* 785.

nately retarded their introduction, so that their results seem to be of the order of independent cooling units rather than of a contribution to the progress of the gas industry.

But after the development of many lines of highly satisfactory winter conditioning units, there came the report by the Committee on Industrial Gas Research[3] which was significant.

Their initial report on this topic says in 1929—

"There are two methods whereby gas can be used for summer air conditioning. A thorough investigation is being made concerning the possibilities of each and the chances of ultimate success appear very promising. It is expected that a contract for research and development will be entered into this fall."

Tests With Silica-Gel

Their report[4] a year later is as follows:

"A study of the requirements for human comfort in summer time showed that not only should the temperature of a room be decreased but that a reduction in the moisture content of the air contributes to comfort to an equal extent. Representatives of the committee began working with the Silica-Gel Corporation to apply this principle of drying air, or dehumidification, to building cooling, as it was shown that burning gas could be used to revivify the Gel after it had become saturated with moisture taken out of the air. This system has been perfected to the point where several very large installations are in operation, mostly using oil. During the summer of 1929, an additional installation using natural gas was made in a Pennsylvania theater. That installation operated through the summer and clearly demonstrated that it is possible to economically apply gas to building cooling using this method. This summer an installation has been made in a large bank building in Baltimore, Maryland, and while a number of minor difficulties have yet to be ironed out, there is no doubt but that the installation will prove entirely successful. While the field for building cooling has not yet been applied to dwellings, every indication points to the fact that we are fast coming to the time when owners of high class residences will consider the installation of house cooling."

"Progress in the application of gas to house cooling is also being made in another direction. The Carrier Engineering Corporation which has been the leader in developing and applying compressor units to building cooling have become convinced that there are real possibilities in applying gas to summer air conditioning. This Corporation has recently begun the development of a system utilizing gas and it is expected an initial installation will be made before the summer is over."

"The growing appreciation of the importance of dehumidification is helping to pave the way for gas cooling. It is quite possible that ulti mately we will have complete air conditioning systems to offer. These will heat and humidify in the winter, and cool and dehumidify in the summer."

In June, 1931, the 5th Report of the Committee was made public. This report[5], the third discussing the house cooling research, while still restrained has at last found the points wherein gas is far superior, and unhesitatingly joined the issue on the principles involved in year round conditioning.

Important Committee Findings

The section devoted to cooling in this report exceeded eight pages of text with 4 illustrations. Only a few very brief extracts can be made. Two paragraphs on page 70 state definitely the conclusions drawn from the laboratory investigation along the lines which seem still to be the most valid for the proper solution of this possible additional load.

"The various engineering considerations that have caused some of the leaders in heating and ventilating to develop and apply different practices, all are important because they have a bearing on the speed with which gas will be sold and also the extent to which it will be possible to finally develop the business. It is our determination to use to the fullest extent the valuable points of each practice. We are projecting gas into the air-conditioning field with the determination to use the versatility of this source of energy to the fullest extent.

"By definitely recognizing in the very beginning that cooling and dehumidifying are two separate operations and setting out to do them separately, we believe that we are laying the foundation for an entirely new technique in the art of summer air conditioning. It is possible that this new technique will enable air conditioning to be sold to an extent that has not heretofore been dreamed of."

Realizing, however, that engineering is less unanimous than many other less exact sciences, the Committee continues its interest in the refrigeration methods proposed by the Carrier Engineering Corporation who have repeatedly stated that in their opinion gas will be the only satisfactory source of energy for household summer air conditioning.

Vital Progress

In spite of the general reduction in business activity in 1931 and 1932, the research on year round conditioning continued with installations being made not only in representative dwellings, but also for commercial and industrial buildings in Dallas and Baltimore. The results of this work were presented by E. D. Milener in a critical analysis[6], "Summer Air Conditioning of Residences," which discusses in great detail the use of capillary attraction for removing excess moisture (the part that produces the oppressive feeling) from the summer air in the home by the use of gas service. The paper concludes with the summary:

"Research and development in this field is not complete. However, at this convention, for the first time is exhibited, as a result of research, practical equipment, which uses the same source of energy winter and summer for supplying the two missing links of year round residential air conditioning. That is progress. What effect that progress is going to have on refrigeration and on refrigeration engineering I do not know. We in the gas industry have approached this subject of summer air conditioning strictly from the viewpoint of its being essentially a part of year 'round air conditioning. We believe that as things develop there will be need for a closer tie-in between our respective fields. That is why we have made our whole approach to this subject an open book and we hope that the work which we have done will contribute toward a clearer understanding of the subject on the part of all concerned, and

[3] *A Year's Contribution of Research in the Application of Heat in Industry, p. 14, Aug., 1929.*

[4] *Improving Industrial Gas Utilization During a Period of Changing Factory Conditions, p. 7, Aug., 1930.*

[5] *Fortifying and Extending the Industrial Use of Gas Through Proper Research and Planning (pg. 65-75, June, 1931).*

[6] *Paper delivered before the American Society of Refrigerating Engineers, January, 1932.*

with that clearer understanding I am sure we will be brought closer and closer together."

That this closer cooperation started is apparent from the Research Committee's Report[7] which states:

"Following the convention of the Refrigerating Engineers, eight addresses on the subject were given before various national and regional bodies as a result of requests received from them."

"As more attention was paid to the subject, the wisdom of the scheme has been recognized. The committee was therefore particularly pleased at the recent action of the American Society of Heating and Ventilating Engineers in adopting a new official comfort chart in which, for the first time, separate summer and winter comfort zones are established, the summer zone being five degrees higher than the winter zone for corresponding humidities.

"The immediate problem facing the gas industry in connection with developing summer air conditioning business is largely a commercial one. With the technique and equipment developed for conditioning buildings with gas by either the dehumidification or modified refrigeration methods, the need is to secure sufficient initial installations so that manufacturers can build up a production at prices that are as low as possible. The Research Committee is making every possible effort to bring this about."

The experience of the users of gas service was excellent, for the year 1933 is one only of results, operating costs, load factors and, best of all, the few words devoted to this phase of the Research Committee's work in 1933 in their annual report[8]:

"The committee early set a goal to work toward applying gas to the average eight or nine-room dwelling. That goal, which now appears to be entirely practicable, was 'Condition a whole house throughout the summer at a cost of $100 or less.' The field tests indicate that a plant for a whole house will be used anywhere from 400 hours to 600 hours per summer, depending upon the latitude."

"Studies, tests and limited actual manufacturing experience in manufacturing seem to indicate that, for the same capacities, gas equipment can be manufactured to sell at prices easily competitive with equipment using other sources of energy.

"During the year additional installations have been made in Philadelphia, Chicago, Baltimore, Brooklyn and Kansas City. Other installations will be completed before the summer is over. The first gas installation in a restaurant was made in Brooklyn, and the first installation in a public library was made in Baltimore. One of the large display buildings at A Century of Progress Exposition is cooled with gas."

And now it is stated that the Committee is cooperating with the University of Illinois Medical School to measure the benefit that hay fever and asthma victims can gain from the gas operated adsorption method.

That the Gas Industry through this Committee is aware of the needs of today's life was seen in February with the first showing of room sized gas operated room coolers. This development is rapidly reaching the production stage.

With the art developed to a point where gas service is available for any and all air conditioning needs, the ground work is laid. It is now necessary that all gas men join in reaching the goal of better load factor by elimination of the summer valley.

[7] *Preparing Industrial Gas Technique to Carry a Greater Share of the Industrial Heating Load, October,* 1932.

[8] *Making Gas a Better Industrial Fuel, October,* 1933.

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To More Efficient and Economical Industrial Gas Regulation

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REGULATOR

Write for Details

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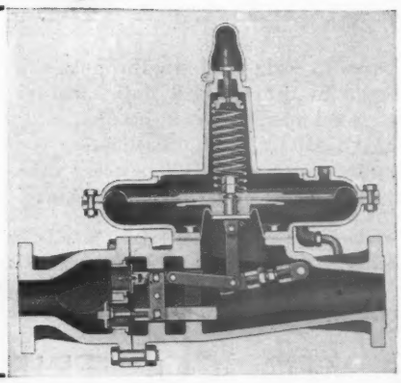
AT THE RIGHT— Cross-Section REYNOLDS NEW Streamlined Regulator which guarantees greater capacity— truer response—more uniform performance



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GAS CONTROL SINCE 1892

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BURNERS

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WARM AIR FURNACES

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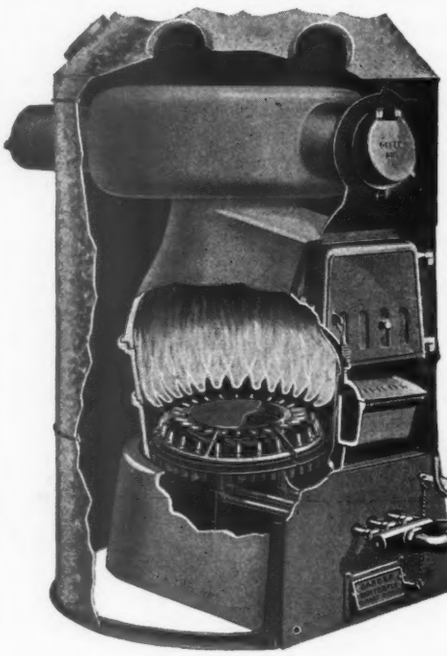
Steam and Hot Water Boilers



Illustrating a No. 324-B Barber Automatic Burner installed in a round warm air furnace. Note the proper position of the burner; its simplicity of installation and the excellent heat-producing scrubbing action of the flame.

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There is none better than the Barber Automatic Gas Burner and Barber Pressure Regulator for warm air furnace Gas Conversion jobs, nor for standard burner equipment for new furnaces, boilers and appliances.

Barber's line of gas burners includes specially designed equipment for warm air heating and air conditioning systems. Make it your answer to the new-day demand for completely automatic heat.

Write at once for full information—NEW CATALOG and latest ATTRACTIVE DISCOUNTS, SELLING CO-OPERATION, ENGINEERING CO-OPERATION in specifying proper arrangement of Barber Burner Assemblies for your particular requirements.

THE BARBER GAS BURNER CO.

3704 Superior Ave. Cleveland, Ohio

Development of The Gas Refrigerator

(Continued from page 128)

ings which we anticipated both in installation and maintenance costs will be more than justified.

The air cooled gas refrigerator in a little more than a year has awakened a tremendous amount of latent interest in gas refrigeration througout the country. Many gas companies that were slow to get back of the old water cooled refrigerator because of water conditions, water rates and several other related problems are now wholeheartedly sponsoring this new product. A national campaign, conceived by and carried on under the auspices of the Refrigeration Committee of the American Gas Association, featuring the air cooled gas refrigerator is now under way. From all indications this promises to be the biggest unified sales campaign on a single appliance ever conducted in the industry.

Gas refrigerators have been sold in the past few years with a two year guarantee against defective parts and workmanship. While quite a number of refrigerators were gradually working out of the warranty period every year we continued to replace parts free of charge until February 1, 1934. At that time because of the increased number of refrigerators already out of warranty it was found necessary to begin charging for replacement parts. No change was made in the policy of free labor service.

In the past, it had been our policy to service gas refrigerators at the request of tenants in apartment houses. It was felt desirable to continue to act upon calls directly from the user who in the majority of cases, however, would not be authorized to approve a charge nor pay for parts that might be needed. To meet this situation a plan was worked out whereby the apartment house owner and the owners of individual refrigerators could contract with us to replace defective parts on annual basis for a stipulated amount. This plan in effect continues the same type of service that was rendered while the refrigerator was operating under the manufacturers warranty at a cost of $2.00 per year per refrigerator for wholesale or apartment house customers and $3.00 per year per refrigerator for retail customers. At this time, less than three months after this new policy was announced, parts replacement contracts for about 50% of the refrigerators out of warranty have been signed. It is, of course, optional with the customer whether he elects to sign the contract or pay for parts as and when needed.

There are slightly over fifteen million homes in this country supplied with gas service. It is estimated that approximately 25% of them have been sold some type of electric refrigeration and another 3% possess gas refrigerators, leaving a balance of 72% without any kind of mechanical refrigeration. This vast unsold market plus an ever increasing replacement market year after year clearly indicates the tremendous possibilities open to the refrigeration industry. The gas refrigerator today is in all respects equal to and in many respects far superior to its electric competitors. With such a product the gas industry has an opportunity to secure a large percentage of this possible market. Is it worth going after?

I think the results obtained by our own company over the past seven years express more forcefully the value of the refrigeration load than anything else that might be stated. At this time we have over 150,000 refrigerators operating on our lines. This means that our refrigeration load alone amounts to more than two and a half billion cubic feet annually. It is interesting to note that there are only fourteen cities in the United States serving manufactured gas that have a total annual sendout of more than two and a half billion cubic feet. Measured in another way our refrigeration load is equal to the entire sendout of an eastern industrial city with a population of over 300,000. Additional load in such proportions from a single appliance would seem to be well worth going after.

Convention Calendar

May

14-18 National Fire Protection Association, Atlantic City, N. J.

21-22 A.G.A. Joint Committee Conference of Production and Chemical Committees, Hotel New Yorker, New York, N. Y.

June

4- 5 Canadian Gas Association, Montreal, Can.

5- 8 The Institution of Gas Engineers, London, England

18-21 National Association of Purchasing Agents, Cleveland, Ohio

September

1-4 International Gas Association, Zurich, Switzerland.

11-13 Pacific Coast Gas Association, annual convention, Hotel Del Monte, Del Monte, Calif. Clifford Johnstone, managing director.

October

Week of 29th—American Gas Association Convention and Exhibition, Atlantic City, N. J.

Laboratory Wet-Test Gas Meters

• *Normal Accuracy Within ½ of 1%* •

Thousands of these meters, now in use all over the world, testify to their unquestionable performance. Accuracy is dependent only upon the water level within the meter. This water level is determined carefully for each meter operating under normal conditions and is readily reproducible. Sustained accuracy is insured by precise manufacture and watchlike workmanship. Few integrating gears minimize resistance to rotation—all rotors delicately balanced on sharp, knife edges. Built for years of service. Before shipment, each meter is proven against a 1/10th cubic foot bottle, certified by U. S. Bureau of Standards.

Complete with Thermometer and U-Tube Manometer

Maximum Capacity of Meter	Volume Per Revolution	Dial Subdivision	Small Dials Integrate To	Rotor, Shaft & Housing	Price
20 Cubic Feet Per Hour	1/10 Cubic Foot	1/1000 Cubic Foot	100 Cubic Feet	Brass	$75.00
				Monel Metal	90.00
				Stainless Steel	100.00
680 Liters Per Hour	3 Liters	1/100 Liter	60 Liters	Brass	80.00
				Monel Metal	95.00
				Stainless Steel	105.00
50 Cubic Feet Per Hour	1/4 Cubic Foot	1/1000 Cubic Foot	10,000 Cubic Feet	Brass	110.00
				Monel Metal	150.00
				Stainless Steel	175.00

Prices for larger meters quoted on request

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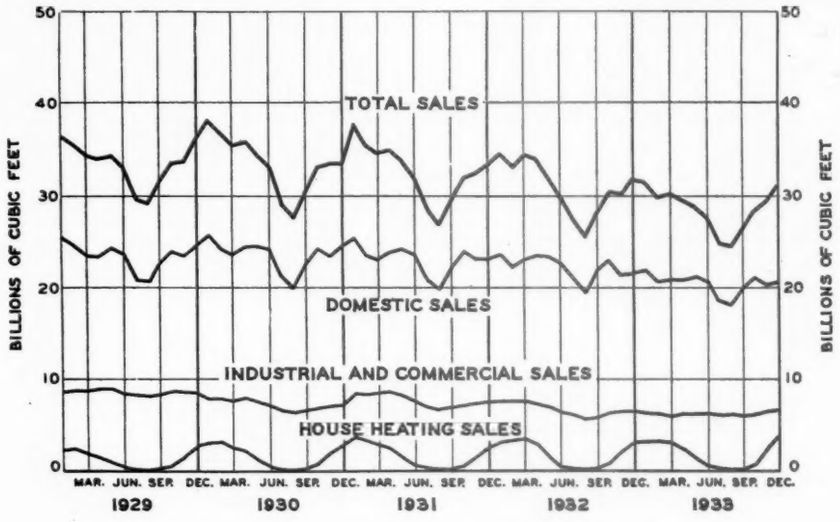
CHICAGO ILLINOIS

History of Industrial Gas Utilization

(Continued from page 104)

approximately 1885 but here the cooking and heating load was added to the gas sales. In 1900, gas for industrial and electric generation was accepted by the industry at large and this is clearly indicated by the tremendous increase in gas sales over the short period of time of natural gas sales for fifty years.



Charts—Monthly Gas Sales: Manufactured Gas.

Charts No. 5 and No. 6 are monthly graphs of the manufactured and natural gas sales respectively, from Mar, 1929, to December, 1933, inclusive. If one studies the industrial send out graphs in both of these charts, it will be clearly seen that the industrial gas sales is the ideal load factor for any gas utility.

In the ceramic industry considerable gas has been used as a fuel but not altogether too scientifically. Recently the Committee on Industrial Gas Research of the American Gas Association in cooperation with the Lenox, Inc., of Trenton, N. J., Prof. Brown of Rutgers University and the Surface Combustion Company of Toledo, Ohio, have developed after several years research, a continuous type direct heated walking beam ceramic kiln for the firing of gloss chinaware, which has been accepted by the industry. This operates at temperatures exceeding 2300° F. with an operating cycle of 2700 hours in a 60' kiln. This is only one of the achievements of the Industrial Research Committee.

The committee is making wonderful progress in the research of the application of a direct gas fire to the vitrification of sheet steel. This in all probability will be made known to the industry within the very near future.

The second and one of importance is that of summer air conditioning. Considerable research was conducted and several actual installations were made using solid adsorbents, such as —Silica Gel, activated alumina and Lamisalite. The result of this will open up a tremendous field for gas sales both in the manufactured and natural gas territories for summer air conditioning.

The writer has refrained from mentioning Hotel, Restaurant and Large Volume Cooking Equipment in this article because he is convinced that it would take several times the space already allotted but he realizes the fact that this is one of the most important phases of our industry.

Sincere thanks for the assistance of those listed below in their contributions to the article and also for the permission given to use photographs are due.

American Gas Furnace Company, Elizabeth, N. J.
Gehnrich Oven Company, Long Island City, N. Y.
Eclipse Fuel Engineering Company, Rockford, Ill.
Surface Combustion Company, Toledo, Ohio.
Mears-Kane-Ofeldt Company, Inc., Philadelphia, Pa.
G. S. Boldgett Company, Burlington, Vt.
Robertshaw Company, Youngwood, Pa.
Standard Gas Equipment Corp., New York, N. Y.
New Haven Gas Light Company, New Haven, Conn.
Peoples Gas Light & Coke Co., Chicago, Ill.
Philadelphia Gas Works, Philadelphia, Pa.
Equitable Gas Company, Pittsburgh, Pa.
The Brooklyn Union Gas Co., Brooklyn, N. Y.
American Gas Association, New York, N. Y.
Byllesby Engineering Co., Chicago, Ill.

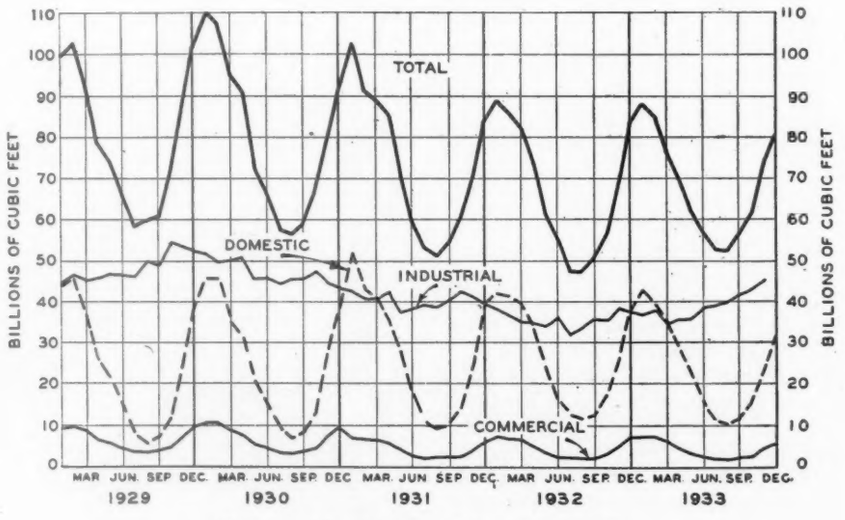


Chart 6—Monthly Gas Sales: Natural Gas

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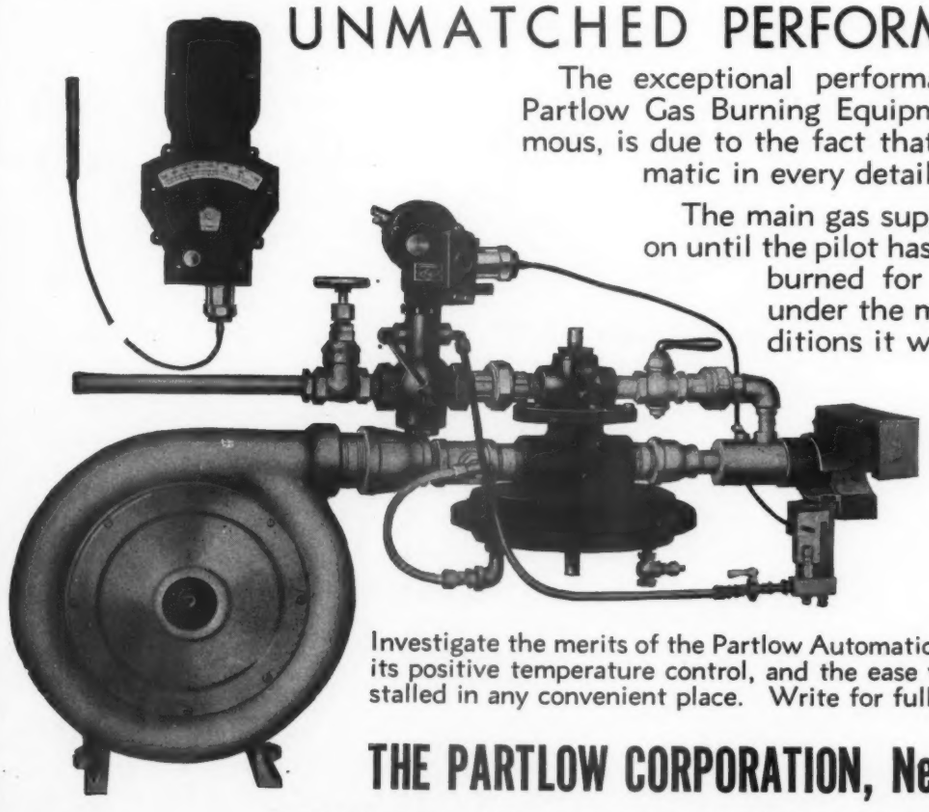

The exceptional performance for which the Partlow Gas Burning Equipment has become famous, is due to the fact that this burner is automatic in every detail and absolutely safe.

The main gas supply cannot be turned on until the pilot has been lighted and has burned for two minutes. Even under the most unfavorable conditions it will not flash back.

PARTLOW
AUTOMATIC
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Investigate the merits of the Partlow Automatic Gas Burning Equipment, its positive temperature control, and the ease with which it can be installed in any convenient place. Write for full particulars.

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Manufacturers of Temperature Controls, Safety Gas Valves and Gas Burning Equipment

Three Old-Timers Upper left—Two Diaphragm, Slide Valve Type, 1846. Right—D. McDonald Co., 1856. Lower left—American Meter Co., 2 Light Wet Meter.

History and Development of Gas Meter

(Continued from page 41)

life of materials employed in its construction.* The present-day meter is a reliable instrument in every respect. It is manufactured under most exacting specifications and may be used with the utmost confidence in its continued accuracy as a measuring device comparable to that of a first-class timepiece.

In the present epoch in the history of the gas meter has appeared the high-capacity consumers' meter, the iron-case consumers' and industrial meter, the Rotary station meter, the Thomas electric-gas meter, the Connersville positive displacement meter, and the orifice meter. In this history, we have confined ourselves chiefly to the briefest of descriptions of principles involved. There has been much development of detail, both in design and materials employed, which has greatly improved the art of measuring gas but of which space does not permit discussion. Perhaps the latest development along this line, and one of far-reaching importance, is the improvement that has been made in the tanning of leather for use in meter diaphragms.

We pause in retrogression of a 75-year period in the gas industry corresponding to the life of the *American Gas Journal.* Since the time of Glover's improvement of the "dry" gas meter, this paper has described upon its pages all of the developments in the gas meter from that time to the present, extending through two epochs of progress. We know it will continue to depict this progress as time goes on, but as to when the present epoch in the development of the gas meter will end we cannot now foresee.

Reminiscences

(Continued from page 27)

delegation of Englishmen came over to Paris to attend the French meeting, visit the International Exposition and see the illumination by Jablochkoff electric arc lamps of the Jardin de L'Orangerie. This being one of, if not the first commercial installations of electric lighting was of great interest to all gas men whatever their nationality.

Between these trips there was the additional contact with the gas business of many days spent at the gas works and gas office in New Orleans. In common with all other gas companies of any size at that time, part of the equipment was a carpenter shop, a blacksmith shop and a meter repair shop. The first two were at the works and the third in an annex to the office. I would frequently spend Saturday morning at the works, dividing most of the time between the blacksmith and carpenter shops, with tours of inspection around other parts of the plant, and Saturday afternoon (there was no Saturday half-holiday in the seventies) at the office and especially the meter shop. Incidentally, at that time the New Orleans Gas Light Co. used wet meters exclusively, conditions as to climate and saturation of the gas with moisture when it reached the meters being very favorable for that type of meter.

When there is added to the contacts which have been described the tacit understanding that I was to become a gas engineer it can readily be seen that I was steeped in the atmosphere of the gas business long before my name found a place on any pay roll.

(To be continued)

John Gilpin Rides Again

(Continued from page 37)

and hostler, of teacher and pupil. And,

"—Ach, Gott, Herr Riley," the closing remarks of Hechter there at last, "As a *horseman,* what an *editor* you would make!"

And *that,* girls and boys, is the *true* story of how the AMERICAN GAS JOURNAL got as its editor the Man on Horseback, Henry M. Riley!

Changing Requirements

(Continued from page 30)

as a significant unit in American practice. It had already been used by the British as a brief way of describing 100,000 B.t.u. And the pricing of gas per therm has been practiced in a number of important cases.

It would be forecast, rather than history, to tell the story of the development of the new system of sale of gas purely on a price-per-unit-of-energy basis. That is a development which is just beginning. It is also a development which is vital to the wellbeing of the industry if it is to gain and hold industrial gas customers in sufficient numbers to furnish the required base-load business of the industry.

When another quarter century passes and *American Gas Journal* has its Centenary Issue, it will be appropriate to discuss the history of adoption of the therm as a unit of gas supply.

Success to the

DIAMOND ANNIVERSARY

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We expect to be in the

CENTENNIAL NUMBER

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The engineering department of GRAVER offers you expert service in modern economies of design and erection. We are equipped to handle low and high pressure gas holders of all types and all accessory equipment of steel plate construction with necessary fittings, either to your specifications or designed to your needs. GRAVER manufacturing and fabricating facilities are unexcelled, yet production costs are low. GRAVER field erection is recognized for its good workmanship. Consult GRAVER on your requirements.

GRAVER TANK & MFG. CORP.

General Offices and Factory
East Chicago, Indiana

Development of Distribution Tools and Equipment

(Continued from page 84)

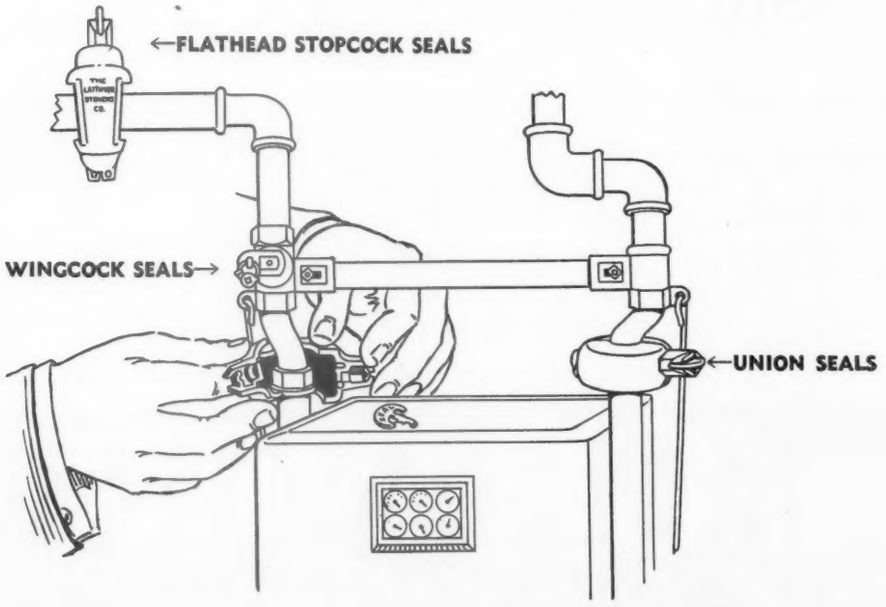
successors. In almost any gas distribution system which has grown over a period of forty years or more there are many underground pipes, the location of which is unknown or imperfectly known.

One of the developments which greatly assists gas distribution men of today in locating underground structures, without undue excavation cost, is the wireless pipe locator. This device which is doubtless well known to most operators of large distribution systems, can, under favorable circumstances, furnish a vast amount of information relative to underground pipe. Quite often in tracing the course of a buried service, the operator of today wonders what mental process his predecessor must have gone through to locate pipes as they are found to exist. The deviation from expected conditions is the factor which makes an instrument of this kind especially valuable.

The foregoing, by no means exhausts the applications of modern science to the problems of the Gas Industry. Many devices and appliances have been suggested and tried out in particular locations and, while they may not have been generally adopted and may require further development, they give at least promise of ultimate success. For example, an instrument has been devised recently which is designed to locate leaks in gas mains and services by sound waves, amplified by radio equipment. Such devices, while doubtless subject to certain limitations, point the way to further developments.

It seems a far cry from the underground pipe line to the airplane, yet the latter has been used successfully in surveying and photographically mapping routes for cross-country transmission lines. Some use has also been made of the airplane in patroling pipe lines. A serious break in a high pressure line throws into the air a cloud of dirt which may be readily spotted from an airplane.

It is only reasonable to suppose that the future will show as rapid progress as the past. The Gas Industry, on account of its age, has often been regarded as an ultra-conservative and unprogressive business. During the past thirty-five years, however, an increasing number of technically trained men have taken up the problems of the Gas Industry as their life work. These young engineers are thoroughly alive to the technical and financial responsibilities of the Industry. They are ready and eager to accept any improvements in equipment or technique which give promise of facilitating work and cutting costs. The American Gas Association through its various agencies has contributed greatly to the solution of our problems, and last but not least, the gas journals have done their bit by disseminating useful and up-to-date information.



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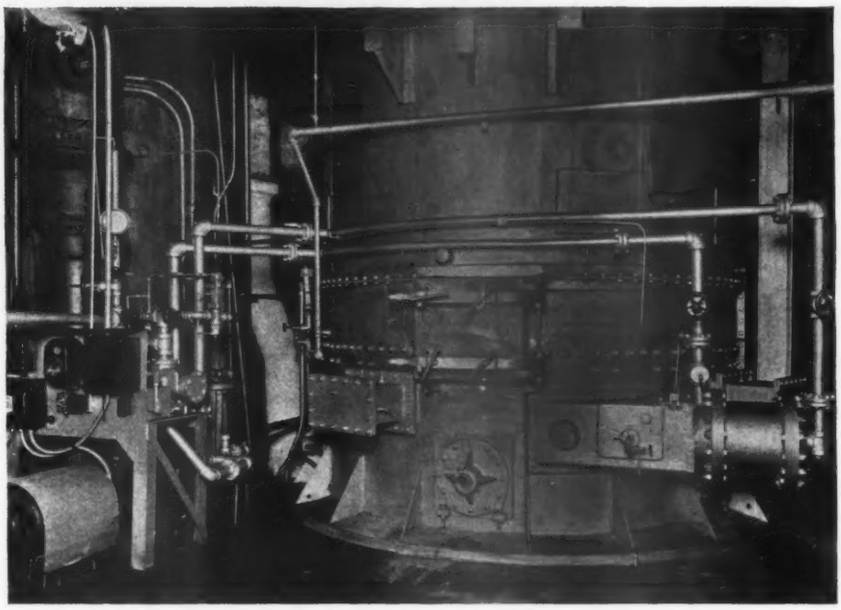
Stopcock Seals for iron body or all brass stopcocks

Samples Free on Request.

THE LATTIMER STEVENS CO. COLUMBUS, OHIO

Three-Quarters of A Century of Water Gas Progress

(Continued from page 49)



A. B. C. Mechanical Grate, Baltimore.

hydraulic control, the Kennedy (Bartlett-Hayward Co.) automatic, hydraulic, electric control, the Western Gas Company's "Piston Type" automatic, hydraulic control, the United Gas Improvement Company's "Type B" automatic, hydraulic control and the Western Gas Company's "Chain Type" automatic, hydraulic control.

The chief contributions of the automatic control are, one—the maintenance of a uniformly timed and desired cycle hour after hour; two—the elimination of minute supervision of set operations, and three—the safety features through maintaining proper sequence of valve movements and furnishing an automatic shut-down in case of failure of electrical supply. The modern controls are far superior to the old controls, from the standpoint of adjustability and flexibility of operation.

Low Pressure Steam and Accumulators—A discovery of more than passing interest to the economics of water gas manufacture was made when it was found possible to substitute the use of low pressure or "exhaust" steam for high pressure steam. This application was first made about 1917-18 and enabled the plant operator to utilize the steam discharged from the plant auxiliaries for process steam in the set. Due to the intermittent demands for exhaust steam, it was necessary to augment the supply with controlled additions of high pressure steam, so that the system did not reach its maximum utility until about eight years later, when the application of the low pressure steam accumulator was made. This device, of which the Smoot is the outstanding example, stored the low pressure steam whenever the demand was reduced and released it whenever the demand was increased. It made a marked improvement in the steam economy of the water gas plant and the use of any high pressure steam "make-up" was practically unnecessary.

Waste Heat Boilers—During this same period the waste heat boiler was developed and perfected. Among the first applications were some which have not stood the test of time, such as one—the use of boilers to extract the heat from the "illuminating" or "make" gases; two—the use of horizontal-type waste heat boilers, and three—the practice of connecting two sets to one blast boiler through the medium of a changeover valve.

All of the later waste heat boiler installations have been of the vertical, fire or water tube type, connected to a single set by means of a suitable "cut-off" valve and arranged to extract the waste heat in the form of sensible heat or heat of combustion from the blast gases only.

Back Run System—An event of importance to the water gas industry which occurred during the years 1923 to 1925 was the inventing and perfecting of the Steere Back Run System, which allowed the gas which was made on the down-run to escape direct to the wash-box without the necessity of traversing and carburettor and superheater. This was accomplished by connecting the wash-box and the base of the generator through the medium of a pipe and suitable valves, the latter allowing for the maintenance of the usual connection between the outlet of the superheater and the wash-box. The down run steam connection was transferred from the top of the generator to the top of the superheater, so that the down or "back run" steam was superheated on its way to the top of the generator by the hot checkerbrick in the superheater and carburetter, which were steam "scurfed" and cleaned as a result. A considerable saving in generator fuel resulted from the adoption of this system. Other systems which were developed during this period to improve set economy were the Chrisman Down-Run Cycle (U. G. I. Co.) and the R. A. B. (reversed air blast system) (Western Gas Construction Co.).

Automatic Grates and Chargers—Although it is reported that Isaac Knapp in 1888 suggested the use of an umbrella or rocking type of grate for automatically removing ash from the generator fire, it was not until 1924 and 1925 that an automatic grate, designed by Taussig of the U. G. I. Company, proved its worth under actual operating conditions. This device was improved upon by Haug, also of the U. G. I. Company, who collaborated with Glasgow, of Humphreys and Glasgow, and is, with some improvements, the forerunner of the U. G. I. Company's present mechanical generator.

In 1926 an A. B. C. (Andrews-Brassert-Chapman) automatic grate was installed by the Western Gas Construction Company in the plant of the Chicago By-Product Coke Company at Chicago, Ill. This grate has since been developed and improved upon, the most notable change being the replacing of the gear drive by hydraulic drive.

The automatic grate has successfully eliminated one of the dirtiest, hottest and most onerous tasks connected with the water gas industry, namely—the usual routine, cleaning of the generator fire. Its use has resulted in more uniform generator conditions and in a higher use factor on the water gas set.

Simultaneous with the development of the automatic grate, we find

the development of the automatic charger, which automatically distributes the desired amount of fuel on the generator fire on each run. Among these devices the Steere (Semet-Solvay), the U. G. I. and the Howard (Western Gas Construction Co.) have been perfected and assist materially in reducing the lost time on the water gas set by removing the necessity for shutting down operations in order to introduce the solid fuel charge. Chargers also assist in maintaining more uniform generator and set temperatures by introducing a small charge every cycle instead of a heavy charge every half hour or more.

Fuel Oil Systems—Faced with the necessity of substituting heavier grades of oil for gas oil as carburant, the water gas industry as far back as 1920 laid the foundations for the present successful adaptation of its equipment to the utilization of heavy and residuum oils. The first successful attack on this problem was made in 1920 by Dashiell of the Philadelphia Gas Works Co., by his invention of the checkerless carburetter and high pressure, nebulizing oil spray. This system employed an empty carburetter as distinguished from the usual checker filled carburetter and used high pressure to atomize the heavy oil.

With this system to build upon, the U. G. I. Company in 1929 developed and perfected its heavy oil system for using fuel oils as carburants and that part of the carbon residues deposited on and in the fire as generator fuel. This system employs the "marginal blast" or secondary air blast at the top of the generator and injects part of the oil on the generator fire, part on the uprun and part on the down or backrun, and the balance in the carburetter, the latter being arranged so as to facilitate the removal of the carbon residues deposited in this chamber.

Shortly afterwards the Western Gas Construction Company developed and perfected the R. A. B. heavy oil process. In this process all of the oil is sprayed onto the generator fire, part on the down or backrun and the balance on the uprun. The fire has previously been heated from below, by the usual blast, and above, by the "reversed blast." This reversed blast is forced down through the fire after having been superheated in the superheater and carburetter, which chambers it also "scurfs." The gaseous products of the reversed blast are either discharged through a "front stack" or are sent to the wash-box.

Another process which has recently been advocated for the use of fuel oil is the Semet-Solvay process, which utilizes an "ignition arch" at the top of an otherwise empty carburetter to vaporize and distill that portion of the oil which is sprayed from nozzles inserted through the walls of the carburetter. These nozzles discharge the oil mist upward and counter to the flow of the gas. The balance of the oil is sprayed onto the top of the generator fire, a portion being delivered during the uprun and the balance during the down or backrun.

Reforming Process—In many localities the gas manufacturer finds at his disposal quantities of oil refinery gas or natural gas at a price which warrants the utilization of such gases as raw material in the manufacture of water gas. Here again, the water gas set has demonstrated its flexibility and adaptability. In 1928 Perry of the U. G. I. Company perfected a method for the "reforming" or conversion of high B.t.u. gases, such as refinery gas, into gases with B.t.u. and physicial characteristics, suitable for city use. Odell developed a method for converting natural gas to gases of lower B.t.u. on a water gas set. In both processes solid fuel and steam are used to effect the breaking down of the higher hydrocarbons.

Oil Gas Process—The most recent demonstration of the all-around utility of the water gas set is the Refractory Screen Oil Gas Process, which is advocated for the manufacture of gases of high B.t.u. as a standby in the event of interruption of a natural gas supply. In this process, a bed of refractory material placed upon a few rows of checkerbrick, takes the place of the usual generator fuel bed. The set is brought to heat by an oil burner temporarily inserted in the generator. When a temperature of approximately 2000 degrees F. has been reached in the "refractory screen," bunker oil is sprayed on the generator fire, both on the "down oil run" and during the "up steam run." The carbon residue deposited in the screen is burned during the following generator blasting period by both up blast and down blast. During the run, gas oil is sprayed into the carburetter in the usual way to enrich the fuel oil gas-blue gas mixture to the required B.t.u.

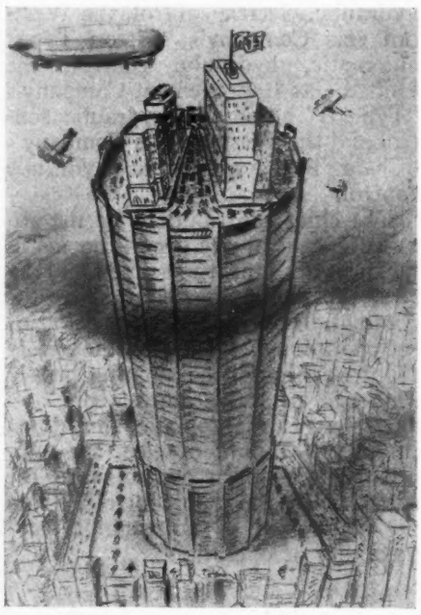
This brings to a close a review of the major developments in the water gas industry during the last seventy-five years. The reader can judge that real progress has been made and that this has stabilized and advanced the water gas manufacturing branch of the American gas industry.

The writer gratefully acknowledges the assistance obtained from articles by F. H. Morton, "A Half Century of Water Gas," American Gas Light Journal, July 19, 1909, and J. A. Perry, "Fifty Years of U. G. I. Gas Developments," U. G. I. Circle, June, 1932, and from the Centennial Number of the Baltimore Gas and Electric News, June, 1916, and various other sources which furnished the basis for this history.

Gas Tanks Now and Then

(Continued from page 79)

try, I have obtained the services of my friend, Ray Martin, to design for me a gas holder in modernistic style, in keeping with the trend of



the times. I have selected as a site for it the old reservoir in Central Park, and believe that funds can be obtained from the PWA for its construction. I am not undertaking, at this time, to disclose whether this type of holder is wet or dry. No one should ask Martin because he does not know either. However, the penthouses atop will create a suspicion that some part of the holder will be moist.

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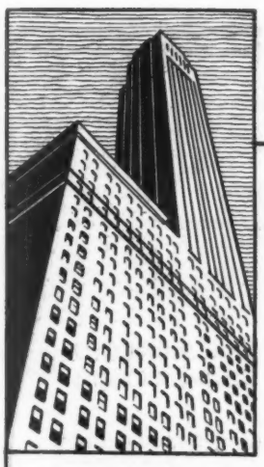

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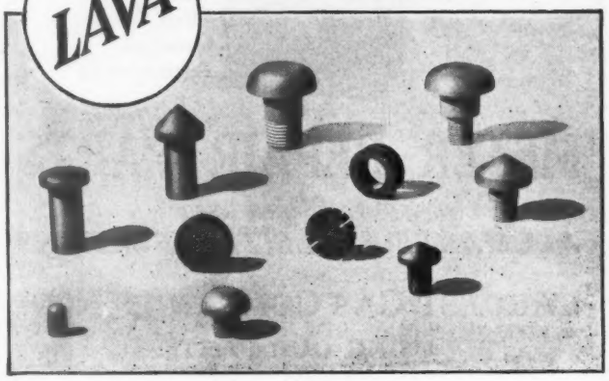

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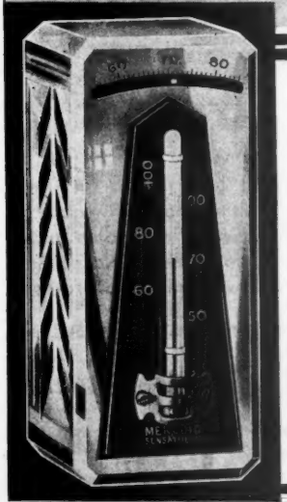

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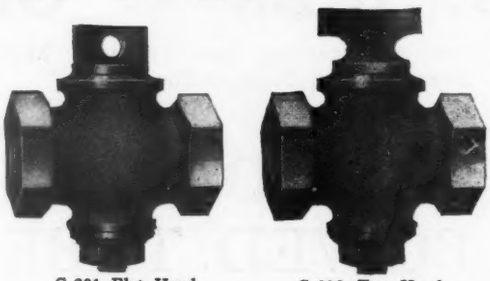

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Condensing, Scrubbing and Purification

(Continued from page 66)

rived from the manufacture of alumina from Bauxite was imported from Europe. It possessed the advantage of being immediately ready for use after mixing with shavings and it was also more active than the old home-made iron borings oxide. Natural bog ores were used during war years, with a scarcity of cheap iron and failure of the European market to supply the precipitated material. Passing over liquid purification which was developed after the war period and will be discussed in following paragraphs, there were no marked changes in dry box purification until about 1930. Then new high powered oxides were developed by all the manufacturing companies. Lavino now has their activated iron oxide, Gas Purifying Materials Company is making a G. P. M. iron hydroxide, Connelly Iron Sponge Company have improved their product and Alpha Lux Company is mixing their precipitated ferric hydroxide with granulated blast furnace slag. These improvements have completely eliminated the old home-made material, in that more than double the sulphur absorption of previous years is now being obtained

Evolution From Cast Iron

Space does not permit a detailed description of the development in purifying boxes from the old cast iron water sealed box operated with a center seal valve to the modern elevated welded steel boxes, with dry seals and elaborate valve systems for reversing boxes, hopper bottom for rapid discharging and elevator with Gantry cranes for filling. The evolution went from cast iron boxes with steel covers and dry seals, housed in buildings, to underground concrete boxes, to outside insulated boxes, to the elevated box. Many organizations, such as the Semet Solvay Corporation, Gas Machinery Company, Western Gas Construction Company, Cruse Kemper Company, Bartlett Hayward Company and Stacey Brothers have been aggressive in making improvements in dry purification equipment.

Boxes have been designed with valve arrangements to permit of backward rotation, reversal of flow through the box, revivification in place. Perhaps the latest development in dry box purification is an installation of the Semet Solvay Engineering Corp. at Havana, in which the box contains four compartments with forward and backward rotating manifold and the material is not removed until fully spent. One compartment is revivified every day. The method of revivification is the recirculation of gas through the box, with the addition of a small quantity of air for the oxygen sulphur reaction. Blowing is carried on until the oxygen passes through the bed of oxide without reaction with sulphur, or change in the original 4 per cent oxygen content.

Liquid Purification

The removal of sulphur by liquid purification process is one of the outstanding developments of the last two decades. Recognizing the need of a process which reduces ground space occupied by dry oxide boxes, which is more economical and, in addition, will remove all the cyanide from the gas, the Koppers Company Engineers, under the leadership of Dr. F. W. Sperr, brought out the Seaboard process about 1920. This process proved to be very successful from the beginning. The gas is scrubbed in a packed tower or absorber with a clear soda ash solution. The spent solution resulting is then aerated in another packed tower or actifier, by blowing a current of air through the descending spent solution. The regenerated soda is recirculated back to the absorber and then through the actifier many times. The air containing hydrogen sulphide and cyanide impurities is discharged to the atmosphere through a tall stack. Where the objectionable odors prevent such a practice, it is conducted to the boilers, producers, or ovens and there mixed with the air supplied for combustion. More than forty-one plants now employ this process, purifying 300,000,000 cu. ft. of gas daily. When complete removal of sulphur from gas is required, the oxide boxes are used as catch boxes to remove the final traces.

When no suitable means to use the actified air in combustion processes are available and the odor is objectionable, one of three sulphur recovery processes may be used, if liquid purification is desirable. The Thylox process, employing arsenic with soda ash as a clear solution, is recommended for locations where the recovered sulphur can be used, either as a fungicide or for sulphur burning. The Ferrox process using an iron compound suspended in soda ash solution may be selected when credit from the sale of sulphur is not so important. The Nickel process is recommended for gases which contain no hydrocyanic process. The scrubbing solution employs a nickel salt suspended in soda ash and the nickel serves as a catalyzer to convert the absorbed hydrogen sulphide to the sulphur. Details of these processes can not be given in this article, since detail has been purposely avoided hitherto.

It is sufficient to state that a thionizer, either of the tube type, flotation machine or pressure tower, takes the place of the actifier of the Seaboard process. Air blown through the thionizer produces a sulphur slurry, which overflows into a tank, is subsequently filtered and the press cake sold as agricultural sulphur. The press cake may be melted in an autoclave and brimstone produced for use in the sulphur burners of paper mills or sulphuric acid plants.

In the candlepower days nitrogen was recognized as an undesirable diluent. The latest practice of today condemns the presence of nitrous oxide, which compound, in the presence of oxygen and certain unsaturated hydrocarbons, results in the formation of a vapor phase gum as a fine fog which defies retention on filters and eventually causes much trouble in pilot stoppages. Even the liquid purification plant fails to retain the nitrous oxide. The use of dry oxide catch boxes made slightly alkaline with a little ammonia in the gas seems to be the best remedy. The United Engineers and Contractors have also developed a new stop pilot of spiral type to combat this nuisance.

This brief summary of condensing, scrubbing and purification practice would not be complete without mentioning dehydration practices, used to remove moisture completely and prevent corrosion of mains. There are a few plants in this country where dehydration is practiced. The Koppers dehydration plant using a solution of hygroscopic salt has been proven very effective. It has been found necessary to prevent dust trouble and excessive leakage of old joints by fogging the gas with oil, using either atomizing or vaporizing equipment. The Western Gas Construction Company has been quite active in this development.

In this present modern age managements are stressing the importance of salesmanship and load building, which is quite essential to the future progress of the industry. Let us not forget, however, that the efforts of research men and engineers have done much to provide a product which meets the very exacting requirements of purity and pressure, to give satisfactory service to the more exacting public of modern times.

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Seventy-Five Years in Gas Analysis

(Continued from page 52)

and, requiring neither thermometric or barometric corrections, it was capable of giving more rapid and comparable analyses. It consisted only of bell-glasses placed within jars as absorption vessels and means for measuring and conducting the gas in and out of these vessels. A solution of caustic potash was used in one jar for absorbing carbon dioxide and in another an ammoniacal solution of ammonium chloride, the interior of its bell-glass being filled with copper gauze. This was used for absorbing carbon monoxide and oxygen. A third absorption jar containing alkaline pyrogallate was also used for determining oxygen separately. The original Orsat apparatus was portable and immediately found favor with gas chemists. The numerous modifications and improvements which have appeared from time to time bespeak a high tribute to the general utility of this instrument and also a keen desire to remedy its shortcomings.

Lunge Nitrometer

About 1880 Winkler, Lunge and others introduced refinements in the Orsat apparatus which made it possible to carry out a more complete analysis, Lunge having added a contrivance for burning hydrogen by means of heated Palladium asbestos. In this period the Lunge nitrometer came into use for certain kinds of gas analysis and also the Hempel burettes and absorption pipettes. The simplicity and ease of manipulation of the Hempel pipettes was appreciated by the fact that they were used by many chemists with increasing favor, and many modifications have appeared. Improved forms are well known to present day gas chemists, many of whom prefer to use them instead of more elaborate and recent apparatus.

Chemical control in the gas-works was being put more and more into practice at this time. It was more necessary to test the raw materials, the by-products and to keep a check on the manufactured gas by analyzing it. Natural gas was being used for heating and lighting, carburetted water gas was being made in plants based upon Lowe's principle, and was coming into use more and more for re-inforcing coal gas, so that the demands upon the gas chemist gradually were growing and especially was this true for the rapid analysis of gas. It was realized that with more efficient apparatus to check the gas composition from day to day that disturbances and fluctuations in the manufacturing processes might come to light. Accordingly, the very important problem of devising more rapid and accurate methods and apparatus for the analysis of gas claimed the attention of a number of investigators.

Elliott's Apparatus

In an apparatus worked out by Rauolt the gas was treated with several reagents, one reagent being removed before another was added. This was only accomplished by washing out the apparatus after each reagent had been used with water in such a manner that no gas was lost in the operation. In order to overcome this difficulty of excessive washing Elliott devised his apparatus in 1883, a description of which can be found in his paper on "A Rapid Gas Analysis" in the Annals of the New York Academy of Sciences, vol. II, page 372. This apparatus afforded a great saving in time over the use of other apparatus and Elliott claims in his paper that after some practice a complete gas analysis, using the absorption apparatus and explosion burette could be made in less than an hour. This was a decided step forward in the analysis of gas and it was followed by the appearance of improvements in the Orsat type of apparatus as well as in the Hempel pipettes.

The Orsat, Hempel and Elliott types of gas analysis apparatus have been continually improved down to the present time; one or another of various forms being used by gas chemists. In addition to the above types an apparatus devised by Morehead has been in use since the turn of this century. This too has been modified and improved, but is widely used in gas plant laboratories, as it meets the ordinary requirements for simplicity in design and operation and gives results that can be readily duplicated.

A very recently improved form of the Orsat instrument is the Orsat-Burrell apparatus, which was devised in order to incorporate the improvements in method and mechanical design resulting from recent analytical research. An important detail is a provision for the slow combustion of carbon monoxide, hydrogen and methane, which eliminates the error due to the explosion of the hydrogen-methane mixture over water.

These various forms of gas analy-

sis apparatus are not adequate for the accurate and complete analysis of natural gas, which contains the lower paraffin hydrocarbons among other ingredients, but no hydrogen, carbon monoxide or unsaturated hydrocarbons. However, they are found useful in determining oxygen and carbon dioxide in this gas and in determining the amounts of manufactured gas ingredients in a mixture of natural gas with coal gas or carburetted water gas.

Knowledge of the chemistry of natural gas and analytical methods for determining its constituents has almost been entirely developed since 1900. The first analysis by fractional distillation was made about 1915, showing the amount of the different paraffin hydrocarbons present, and apparatus for analytical gas fractionalism has only in recent years reached its greatest development, chiefly in the hands of W. J. Podielniak.

Gas analysis has in recent years been enriched with a vast amount of knowledge; old methods and apparatus have not only been modified and improved but the subject has been investigated from new angles, so that it is distinctly a separate division of analytical chemistry and has been brought by improved technique to a degree of accuracy comparable with any of the branches of analysis used in control work.

The field for its application has been extended to such a degree that it not only covers the analysis of coal gas but also blue gas, carburetted water gas, producer gas, coke-oven gas, natural gas, mixtures of natural and manufactured gas, refinery gas, flue gases, gasoline vapors in the air, automobile exhaust gases and others.

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Early History of Gas Appliances

(Continued from page 111)

tion shows one placed on the market in 1880. It had a flue connection to carry off the products of combustion, and an air inlet to carry fresh air from outside the room to the heater. A test of a 9 inch reflecting heater, with illuminating burner showed an increase in temperature, in 37 minutes, of 20 degrees, with a consumption of gas of 6 cu.ft. Fifty cu.ft. of fresh air were admitted to the room through the heater.

No. 19.—Open Fire-Place Heater.

American Meter Co., 1881.

One of the earliest gas logs put on the market was manufactured by American Meter Co., New York and Philadelphia, Pa., in 1883.

About the same time the Sheldon Gas Stove Co., Providence, R. I., introduced a gas stove with an oven attached between the stove top and the chimney outlet.

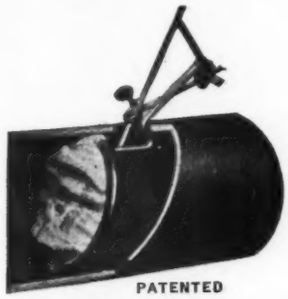
From this beginning has come the development of the highly efficient, radiant type of room heaters as we know them today.

None the less, one must draw the inference that, up to now, the manufacturers, assisted by some gas companies here and there, have done yeoman duty in furnishing the ultimate user with appliances that leave little or nothing to be desired.

What the future will produce in this connection is problematical; but we may be sure that greater advancement will be made in the next twenty years than in the past two decades.

STOPPERS SINCE 1897

THE GOODMAN STOPPER



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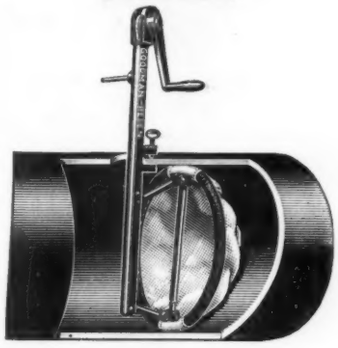

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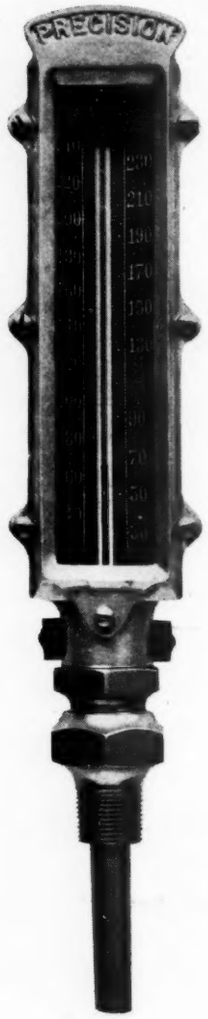

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Some Coal Gas Notes

(Continued from page 44)

equipment and larries plus gravity have been made to fulfill the same functions as once performed by the more elaborate but less efficient charging and discharging machines.

Increase in coke yield and conservation of the coke have been advanced by the invention of numerous quick quenching devices the newest of which—dry quenching (introduced within the past ten years)—snuffs out the fire of hot coke after its discharge from bench retorts without the addition of deleterious moisture.

It is not the purpose of this reminiscent chronology to discuss the changes and progress made in coal gas equipment auxiliary to the generating apparatus itself. Even a condensed tale of the changes wrought in the designs of hydraulic mains, stand pipes, condensers, washers and washer-coolers, ammonia scrubbers, tar extractors, exhausters, purifiers, by-product recovery and refining apparatus and metering and storage facilities would occupy more space than has been allotted to this general topic. Suffice it to say that the progress in all of their designs has paralleled that of the bench itself and reflects a full realization of the important parts they all play as direct correlaries to coal gas manufacture.

Ideas on the need for and extent of housing gas plants have undergone many modifications. It was once deemed necessary to enclose all component parts of a plant even including holders or gasometers. With the advances in the art of plant design each element thereof has gradually emerged into the out-of-doors until at the present time practically all sections of major equipment entering into the make-up of the intricate mechanism of a coal gas plant are unhoused, only sufficient housing being used to afford adequate protection of labor and delicate apparatus and to prevent spoilage of materials.

The coke oven, representing as it does the maximum overall efficiency in mass carbonization of coal and greatest economy of operation through the development and disposal of byproducts, is without doubt the present ultimate in coal gas production for such situations as will permit of its employment and it is to this branch of the industry that much of the credit is due for many of the effective improvements made in coal gas bench and plant design.

While writing of economics, even in the abstract, it would not seem amiss to point out here that without the development and profitable sale of by-products, a coal gas plant as such would today have little or no place in the economic structure of the public utility business. How different this from the older times when coal gas sold for $5.00 or $10.00 per thousand cubic feet and even coke was so much dross and no products from the carbonization of coal were recovered other than the gas itself.

In this country there are approximately 7,800 cities and towns having gas service; of these, 3,070 are served with manufactured gas and, of this latter figure, 1,770 are utilizing gas produced in whole or in part by the carbonization of coal. This indicates that the first of our manufactured gases is still doing a vigorous business.

In jotting down these notes no thought has been given to prescribing a setting,—economic or otherwise, for coal gas in preference to its companions, water gas, oil gas or the rapidly growing natural gas which has already outstripped the others in economic usefulness. At the present writing each has its field.

Practically all of the worthwhile changes in coal gas manufacture, and apparatus design and construction have been made since the advent of the *American Gas Journal* into the public utility field in 1859 and its sponsors may well be proud of the fact that through its prolific and honest dissemination of data and information it and they have contributed to its present state of perfection.

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Home Service Fifty-Five Years Ago and Today

(Continued from page 132)

Home Service branched out considerable since 1879 when Miss Dodd first gave cooking lessons in Brooklyn. There are now more than 300 Home Service departments in gas companies with over 800 Home Service workers. Gas companies in practically every state in the Union are represented in this list. Twenty-eight manufacturers of gas appliances also have Home Service directors to co-operate with the gas companies in making the public gas conscious.

The present activities of Home Service are varied and the following summary of some of the recommendations of the 1933 Home Service Committee, as to how Home Service can best meet present day problems and accomplish its vital objects, gives a very good idea of its development and scope:

Customer Service:

(a) Home Calls
  (1) Following the installation of new appliances.
  (2) Complaint Calls.

(b) Lecture-demonstrations in company quarters or outside.

(c) Individual instructions, which permits women to prepare food in company kitchens, making use of the newest equipment, under the direction of the Home Service staff.

(d) Assistance in kitchen planning which promotes good will and raises equipment standards.

(e) Neighborhood projects, work with foreign groups, classes for school children and their parents, classes in which small groups of brides or domestics actually use appliances.

Trade Dealer Co-operation:

(a) Home Calls—Sales follow up and complaint calls.

(b) Instruction to dealer salesmen and dealer organizations.

(c) Demonstrations for dealer groups.

(d) Kitchen planning service.

Publicity Works:

(a) Columns in newspapers or co-operation with newspaper cooking schools.

(b) Radio work.

(c) Tie-ins with organizations offering a home-making program, in order to insure a true story of gas.

Home Service is now a vital part of the gas industry as it is building good will, creating a desire for modern gas appliances, and increasing gas consumption.

History of Distribution Practice

(Continued from page 90)

Numerous outside agencies have had vast effects on the gas industry. One of the most important of these was the organization of electric light and power companies, the first of which was formed in 1881. Although the electric current took from the gas industry what had been a base load, the gas industry proved it contained vast resources of inventive and sales genius which sought and developed numerous sources of revenue.

Along with the auto came the improvement of road surfaces. In 1893 we find the first concrete roads being placed, but by 1908 only a relatively few miles were in existence. By 1923 the tremendous addition of approximately 6,000 miles per year was having its effect on our economic as well as technical activities.

That our transmission and distribution systems warrant all the effort that can be put into them, is indicated by the fact that it is estimated that over 4,000 miles of sub-surface pipe lines exist, of which one-half are in the oil and gas industries.

The past seventy-five year period, with its innumerable developments, has brought the gas industry from a minor to a major industry. Looking backward we see a reflection of the tremendous future possibilities for the intensive use of gas.

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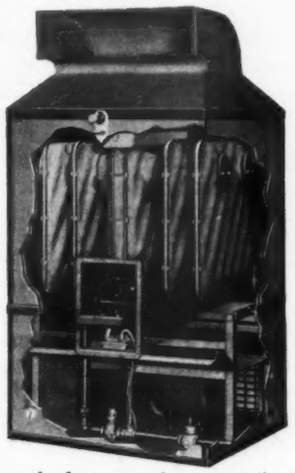
Note the long, sweeping corrugations in the radiator sides and the Niagara Central combustion chamber

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Central Combustion Chamber. The heated gases are all generated in a central radiating section. They pass into connecting side sections and fill them, even on light loads, which condition prevails perhaps 70% of the time. *All* the heating areas are utilized. This means a remarkable efficiency and economy. Moreover, with all the radiating faces giving forth heat evenly, room temperatures are kept more uniform.

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The Development and Progress of the A G A Testing Laboratory

(Continued from page 122)

back-fire. Numerous other tests include examination of the performance of the appliance as a whole, as well as the performance of every control and accessory attached thereto. Efficiency, capacity, strength, convenience, and the justification of special claims are also considered.

It is a significant fact that the Association's testing and certification program does not stop with the testing and approval of appliances in its laboratories. An elaborate system of inspection is maintained. Every model of every type of appliance sold as an approved product is inspected at the manufacturer's plant at least once each year by Laboratory inspectors to insure that all appliances offered for sale to the public and bearing the Laboratory Seal of Approval, are constructed exactly as the model or models approved by test. Approval, at the time of original compliance with the requirements, is given to an appliance only for the balance of the calendar year. In order for the manufacturer to secure renewal of approval he must submit to an inspection of his products at his factory. Approval is renewed in any case only for one year. In addition to the right to use the Laboratory Approval Seal on his products, the manufacturer is presented with a Certificate of Approval covering each model approved. Certificates are valid only for one year, but may be renewed upon the completion of a satisfactory inspection. Laboratory inspectors travel approximately 45,000 miles each year in the exercise of the Laboratory's regulatory powers over the production of certified appliances.

The activities of the Laboratory, however, have never been totally restricted to the routine testing of appliances, inspection, the development of sound requirements, and other duties connected with the Association's approval and listing programs. Research has always constituted a vital and important phase of the Testing Laboratory's interest. In October, 1930, Mr. N. T. Sellman, Secretary of the Laboratory Managing Committee, said, in introducing a report to the Twelfth Annual Convention of the Association:

> "Original plans for the establishment of the Association's Testing Laboratory were based principally upon the assumption that during the first few years of its existence it would be engaged largely in appliance testing work. As time passed, it became evident that an increasing portion of its activities would be devoted to research. At this date, approximately five and one-half years after its foundation, it is interesting to . . . note the marked growth in the amount of investigational work. During the past year, sums expended for research exceeded those of three years ago by 168 per cent. . . . "

It is a significant fact that despite the very unfavorable business conditions which have prevailed throughout the past four years, research activities at the industry's central testing and research institution have been aggressively carried forward.

Each of the subcommittees of the A. G. A. Approval Requirements Committee engaged in the preparation of test standards is continually assigning gas research problems to the Laboratory. The number of such special studies handled per year by the Laboratory probably averages about 100, and includes projects of all magnitudes and varieties, some requiring only a few weeks to complete while many others extend over months and in some instances require years to arrive at a satisfactory solution. At its present stage of growth, the Laboratory undoubtedly is better equipped to cope with such a wide variety of gas appliance and accessory problems than any other single agency. Practically every conceivable phase of domestic gas application may safely be said to have been touched upon at one time or another and in greater or lesser degree by the Approval Requirements Research Department of the A.G.A. Testing Laboratory. Nearly every specification accepted by the interested committees is in part a result of extensive Laboratory research. A listing of these projects would manifestly be quite impractical. Notwithstanding, it is definitely known that these investigations have exerted a marked effect upon the design of new appliances, and are not only of tremendous im-

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portance to the success of the whole testing program, but are of exceedingly great value to appliance manufacturer members of the American Gas Association.

Apart from research associated with the development of approval, listing and installation specifications, the Laboratory is also always engaged in several major research projects of extensive influence and great importance to the industry in general. These problems, usually financed by special appropriations by the Executive Board at the instance of A.G.A. committees interested in particular phases of the gas business, extend into many fields and frequently require years to complete.

Listed below are some of the more extensive research investigations conducted by the American Gas Association Testing Laboratory:

- Mixed Gas Research
- Cast Iron Pipe Joint Research
- Development of a Method for Testing Welded Pipe Joints
- Investigation of the Characteristics of Burning Gas With Preheated Air
- Research in the Elimination of Noise in Industrial Gas Burners (completed)
- Research in Fundamentals of Combustion Space Requirements in High Temperature Gas Furnaces (completed)
- Investigation of the Effects of Operating Temperature Upon Industrial Gas Combustion
- Investigation of the Effects of Furnace Pressure Upon Industrial Gas Combustion
- Research on Heavy Duty Hotel Ranges
- Special Investigation of Automatic Ignition and Safety Devices for Gas Ranges
- Study of the Flow of Gas Through Orifices
- Investigation of Domestic Cooking and Water Heating by Gas and by Electricity
- Investigation of the Effects of Gas Savers on the Performance of Gas Appliances

The Mixed Gas Research carried on at the Laboratory under the supervision of a committee, headed by Mr. F. C. Weber, serves well to illustrate the scope and significance of certain Laboratory research activities. This study, which extended over some five and one-half years, involved the making up and use of more than 250 different kinds of gases, and the making of over 175,000 separate tests. This study will unquestionably prove of increasing value to our industry through the years to come.

It will be seen that the American Gas Association Laboratory, conceived, supported, and operated by the gas industry, affords an unbiased source of original constructive thought and a common central agency serving as a medium through which interested member companies may enjoy services and resources otherwise unavailable. In both of these roles, as well as in the essential one of supplying the means by which the gas industry regulates itself in the public's interest, the American Gas Association Laboratory has, in the nine years of its existence, been eminently successful.

The Gas Show Window A Youngster That Matured Rapidly

(Continued from page 135)

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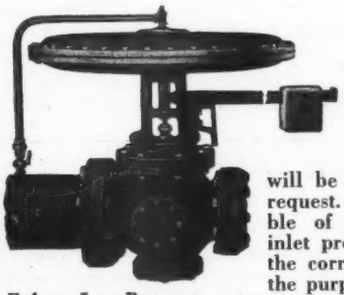

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